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A THEORY OF DEMAGNETIZATION.

In another column we print an interesting article by Messrs. Houston and Kennelly, on the relations that should exist between the length, cross-section and magnetization of a permanent magnet in order that it shall retain permanently its magnetic strength. This is a question of considerable importance in connection with the use of permanent magnets in measuring instruments, and the general solution of the authors, therefore, has a practical value besides being an interesting addition to magnetic theory. It was found in general that if the value of an expression deduced, and containing the known data of a permanent magnet, is not below a certain value the magnetism is permanent, and numerical examples show that this deduction agrees with the empirical rule of Hookham. It is also shown that certain conditions with respect to seasoning are necessary, and that certain proportions may be chosen to give the magnet the most efficient form for a given purpose.

WHAT IS INVENTION?

In another column Mr. Gustav Bissing discusses a recent decision of the United States Supreme Court which, under one interpretation, greatly limits the patentability of inventions. The suit to which the opinion applies related to a mechanical process entailing a number of different operations, the patent being based upon the nature and sequence of these, but without claiming invention in any one. The decision of the court was that the process was not patentable, and it may possibly apply to all mechanical processes. As against this latter view, however, it is shown that the court quoted a case in the suit in question, in which a patent on a mechanical process was held to be patentable. In this case the machinery necessary for executing the process was old, and the prior use of elements in the process was acknowledged. In conclusion Mr. Bissing discusses the meaning of the much abused phrase "the function of a machine," which he considers may admit of a definite interpretation. "If a process which is carried out," he says, "by a machine involves no inventive idea in the "process as such, irrespective of the machine, then the process is "for the function of the machine; otherwise it is not. This is "all there is to it. The phrase adds nothing to our knowledge; it "describes a conclusion, not a cause; it gives us no criterion for "determining the patentability of process; it is merely a descriptive "title applied to such processes as have, from entirely independent "considerations, been found to be unpatentable. To attempt to "use it for determining patentability is to turn logic upside down." We are, therefore, brought back to the definition of the word "invention," and owing to the difficulty of the case we shall probably continue to lack a legal definition, each case depending for its decision upon the personal views of non-technical judges, based on what they consider to be its particular merits rather than upon any guiding and permanent principle.

THE NEW YORK SUBWAY COMMISSION.

One of the New York municipal departments that should have received early attention from the reform government is the New York Subway Commission, but for some occult reason it has been about the only one entirely neglected. Mayor Strong has now only a few weeks left in which he may exercise his power of summary removal, and we trust that before the expiration of this period he will see fit to inquire whether the present Subway Commission might not with advantage be submitted to a process of reorganization. Many will recall the scandalous deals in the first years of this Commission,

when Maurice Flynn, through Jacob Hess and his father-in-law, Theodore Moss, obtained control of the subway rights and finally turned them over to the Metropolitan Telephone Company and the Western Union Telegraph Company, who together own all the subways for low tension wires and possess the exclusive right to construct further extensions in the streets of New York. It is claimed that the prices charged by this monopoly are extortionate and its regulations extremely onerous, and that the Subway Commission has always been subservient to private interests. That the ownership of the subways should be with these monopolies is in itself a scandal, and while it may now be too late to remedy this evil, the protection of what rights are left to the public in the matter should be placed with a body entirely above suspicion. This requirement is not fulfilled by the present Commission, which is the result of a Tammany-Platt deal, and therefore can be legitimately considered hostile to public interests. Were no other evidence present, the fact that Jacob Hess, one of the members in the days when gross corruption was openly charged, was retained, is in itself sufficient evidence that the deal was not made in the interest of the public. At the present time especially, owing to the expiration of the Bell Telephone patents, the status of the Metropolitan Telephone Company with respect to the subways should be cleared up and the various charges made as to extortion and arbitrary rules thoroughly investigated. In order, however, that this may be done, the majority of the present Commissioners will have to be replaced by men whose entire devotion to public interests is beyond question, and this duty is one that Mayor Strong cannot well neglect. It is well to add that one of the Commissioners, Col. Kearney, is free from the objections applying to the majority of the Commission, his appointment having been made in the line of promotion from the position of subway engineer. Neither he nor Dr. Wheeler, the electrical expert, has ever had part in the political and other manipulations that have brought the Commission into disrepute, their connection with it having always been a purely professional one.

MATHEMATICS AND PHYSICS.

In another column a correspondent challenges some editorial remarks made by us several weeks ago on the subject of the present method of teaching higher mathematics, but his letter shows that he has entirely misapprehended our position. We did not assert that only those parts of mathematics should be studied capable of direct application, nor did we intend to convey the impression that we are in sympathy with the prevailing sentiment in favor of a purely industrial training as opposed to one in which the teaching of principles and not of details is the main object kept in view. On the contrary, we have uniformly held that the teaching in technical schools should be directed to the broadening of the student's mind and to his thorough instruction in the principles of science, as the workshop and practical training he receives there is not only amateurish in character, but can be much better acquired after graduation in the vocation adopted, while the opportunities for intellectual development thus displaced are usually lost forever. We may here remark that in a recent address Hon. Eckley B. Coxe, who has had ample opportunities of observation among his numerous technical employees, said that the young man of liberal scientific education, while at a disadvantage with respect to one having a practical technical training during the first two years, after that period, however, usually begins to forge rapidly ahead of the latter, and soon entirely outdistances him. To return to our subject, what we criticised was not the study of higher mathematics, but the method by which it is taught. The question is akin to the old one of the relative value of instruction in dead and living languages, which we believe has been definitely decided in favor of the latter. What we contended for was that the higher conceptions of mathematics, such as rates and space analysis, should be taught in connection with physical phenomena, and not as mere abstractions. By so doing the ideas would take on a real significance, and both the mathematical and physical principles would be more clearly comprehended, one aiding the other. If, for instance, instead of a point A in mathematical space, we took a point in a medium subject to a stress whose laws implied the given conditions, the understanding of the mathematical interpretations would be assisted at every point by the physical conditions of the problem, their limitations and complications being clearly indicated by the nature of the phenomena under consideration. In this manner mathematical principles could be established and their deductions illustrated, while the imagination would have a scope much broader than when confined to mere abstractions. But few minds can readily deal with the abstract without lengthy training, and while this training has its value, the other method is more in accordance with the habits of scientific thought, dealing with phenomena and not with metaphysics. In order, however, for mathematics to be taught in this manner, the teacher must also be a physicist, and we therefore believe that not much progress will be made until the more advanced courses of the professor of mathematics are transferred to the chair of mathematical physicist.

Contact Resistance of Metals.

In the *Comptes Rendus* of the 22d ult., M. Edouard Branly describes some experiments recently carried out by him in regard to the electrical resistance between two sheets of metal in close contact with each other. M. Branly employed thin sheets, 48 mm square, piled one on the top of the other and compressed together by a weight of six kilogrammes. Electric connection was made with the column by means of sheets of brass at the top and bottom of the pile of plates. When a sheet of zinc was placed between two of copper, the contact resistance was very small and remained constant; but when a sheet of aluminium was placed between two sheets of bismuth, the resistance was quite appreciable and increased with time. Thus, in one experiment, the resistance was, to start with, 0.4 ohm, and 25 minutes after the contact had been made it was 0.74 ohm, and five hours after it was over three ohms. If the experiment was varied by putting the sheets of bismuth together and separating the aluminium from the bismuth by a sheet of brass, there was no appreciable resistance. M. Branly remarks that his experiments show that for certain metals, such as copper and zinc, the surface of contact is not the seat of any appreciable resistance; but for others, such as lead aluminium, lead iron, tin aluminium, tin iron, bismuth iron, bismuth aluminium, etc., there is an appreciable resistance. When the six-kilogramme weight was replaced by one of 26 kilogrammes, the resistances at the beginning and the resistances as measured later on were smaller, and the same was the case when the pile of sheets was compressed in a vise; but in all these cases a higher resistance was found than one would have expected according to current notions, and this resistance always increased with time. The contact resistance of two metals in air can, M. Branly states, be altered by mechani al shock or by electric spark.

Operating Canal and River Locks by Electricity.

Within the last few years it has been found necessary to build new locks alongside the existing locks (at Ymuiden) in Amsterdam, in the canal which connects the city with the North Sea. These locks are now nearly completed. It will be remembered that in June, 1893, plans were invited for hydraulic and electric transmission of power for operating the locks. It was found that none of these plans fulfilled the required conditions, and the senders were invited to submit revised plans. The result of the subsequent comparison was that two manufacturers were invited to conjointly make the preliminary trials at Ymuiden. These trials will consist principally in measuring exactly by electric machinery the power required to open the doors of the new locks. In a temporary shed, in close proximity to the locks, the necessary boilers, engines and dynamos will be placed to generate the electric current. This current will be carried through overhead cables, and will be used to turn two capstans, having a force of 5,000 kg by 20 cm and 10,000 kg by 10 cm velocity per second.

To this proposed installation also belong large storage batteries, powerful enough to act as auxiliaries in operating the locks for a certain length of time, should emergency require it.

The Quantity upon which a Knowledge of the Nature of Electricity and Magnetism Depends.

BY REGINALD A. FESSENDEN.

All that we know of the properties of the ether can be summed up in the first three of the following equations:

A. $$q/b = k^{\frac{1}{2}}/\mu^{\frac{1}{2}}$$

B. $$k^{\frac{1}{2}}\mu^{\frac{1}{2}} = T/L$$

C. $$qbk^{\frac{1}{2}}\mu^{\frac{1}{2}} = ML$$

D. $$k^{\frac{1}{2}}/\mu^{\frac{1}{2}} = Z$$

where q, b, k, μ, are the dimensions of quantity of electricity, quantity of magnetism, specific inductive capacity and permeability, respectively.

The second equation is Maxwell's well-known formula (Maxwell, vol. 2, page 434, Elect. and Mag.) and concerns wave motion in the ether.

The first equation is derived from Weber's law for the equivalent magnetic shell and circuit carrying current. For, from this we have

$$\mu \times q/T \times L^3 = bL.$$

The third equation is obtained from Faraday's law, that the voltance in a circuit is measured by the time rate of change of magnetic induction in that circuit, joined with the fact that quantity of electricity × voltance = work. Thus,

$$dN/dt \times Q = ML^2T^{-2}$$

We have thus only three equations* to determine four unknown quantities necessary to a knowledge of the true nature of electricity and magnetism.

We are therefore obliged to form another equation, having for one of its terms an unknown quantity, Z. Let the quotient of specific inductive capacity by permeability equal this unknown quantity, as in equation D.

Solving these equations, we get

E. $$q = M^{\frac{1}{2}} L T^{-\frac{1}{2}} Z^{\frac{1}{2}}$$

F. $$b = M^{\frac{1}{2}} L T^{-\frac{1}{2}} Z^{-\frac{1}{2}}$$

G. $$k = TL^{-1} Z$$

H. $$\mu = TL^{-1} Z^{-1}$$

Now, by giving different values to Z we can obtain all the modern electrical theories, *i. e.*, those which are consistent with themselves; for, as we shall see, at least one theory is impossible because self-contradictory.

1. Let $Z = L^2 TM^{-1}$, then μ is a density, k is the reciprocal of an elasticity, and electric current $= L^2/T$ and magnetic induction $= M/T$.

2. Let Z = the reciprocal of this, and we get k as a density, μ as the reciprocal of an elasticity, the electrical and magnetic quantities in the first theory being interchanged as to dimensions.

3. Let $Z = T/M$. Then,
Quantity of electricity $= L$,
Current of electricity = velocity,
Voltage = force,
Magnetic induction = momentum,
Magnetizing force = velocity.

This is one of the most commonly received of electrical theories, and may or may not be true. But to it is generally joined the theory that μ is a density or the reciprocal of an elasticity. We see, however, that this is impossible, for if magnetism be momentum, μ cannot be either density or reciprocal of elasticity, but must be M/L.

*It might be supposed that the electromagnetic rotation of light would give us a fourth equation, but it appears to the writer that Lord Kelvin's proof that there must be some actual rotation in a body which is rotating the plane of polarized light under the influence of magnetism, is not conclusive. For we are able to produce, by suitable arrangement of plates, a model of optically rotating quartz, and so it would seem that if the electric charges on the atoms are not symmetrically disposed about the centres of the atoms, the purely mechanical stresses due to magnetism, might produce optical rotation, in which case it should be possible to produce the same effects by pressure obtained in any way. Or, since the atoms carrying charges are vibrating in every direction, we have really an infinite number of electric currents, and it is obvious that when such a system is placed in a magnetic field, the velocity will be greatest in a direction parallel to the current in the nearest part of the magnetizing coil, as if the motion be otherwise, work will be done in forcing the atom to move in that direction. In either case we only get an equation between electrical and magnetic quantities which is implicitly contained in the first three equations.

4. This theory is obtained by giving Z the value M/T, when the dimension given in theory three are simply interchanged.

5. Let $Z = M^{\frac{1}{2}} L T^{\frac{1}{2}}$. Then,
Quantity of electricity = moment of inertia,
Current = angular momentum,
Magnetic induction = angular velocity,
Electrical potential = angular acceleration,
Magnetizing force = angular momentum.

This may be modelled by attaching a mass by a rigid arm, loosely to a revolving shaft. It is then evident that the angular acceleration of the shaft (difference of potential across the ends of a wire) will determine the angular velocity of the mass round the shaft (quantity of magnetic induction produced by the current). This represents one well-known theory.

6. The reciprocal theory to five, an equally well-known theory, is got by giving the reciprocal value to Z.

It is thus evident that we can obtain an infinite number of theories by giving different values to Z. This quantity, Z, then, is the one which we must know before we can know what electricity really is. These equations also suggest a number of experiments as possibly throwing light on the subject. For instance, does an anchor ring wrapped with wire weigh more when a current is passing through the wire than when not? Does light travel faster along the centre of a magnetizing helix than in free air?

Another point becomes very obvious. That is, that the accepted dimensions of electrical potential and force are incorrect, even when we have taken into account μ and k. For the potential of a point is defined as the work which must be done in moving unit quantity from that point to infinity. Therefore the dimensions of quantity are included in those of potential at a point. But in every table of dimensional formula, this factor has been left out, it having been, apparently, supposed that, since we multiply the numerical value of the potential at a point by the numerical value of the quantity, to get total potential, that we must multiply the dimensions of potential at a point by the dimensions of quantity to get the dimensions of work. *But potential at a point has already been defined with respect to unit quantity, and already includes the dimensions of quantity*, so that the usual method is incorrect. Our estimation of the results of multiplying 10 volts by three coulombs should therefore read,

$$10\ M\ L^2\ T^{-2} \times 3 = 30\ M\ L^2\ T^{-2}.$$

If we correct the usual formula in accordance with this consideration, then we have the following table, which is correct on any theory of electricity, no matter what the true nature of electricity and magnetism may be:

	Usual Formulæ.			Proposed Formulæ for all Systems.
	Electrostat.	C. G. S.	Electromag.	
Quantitity of elect..... Strength of pole.....	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$	$L^{\frac{3}{2}} M^{\frac{1}{2}} T^{-1}$	$L^{\frac{1}{2}}$	Unknown.
Elec. force at point ..... Mag. force at point.....	$L^{-\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$	$L^{\frac{1}{2}} M^{1} T^{-1}$	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-2}$	$L\ M\ T^{-2}$
Electric potential..... Magnetic potential.....	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-1}$	$L^{\frac{1}{2}} M^{\frac{1}{2}} T^{-2}$	$L^2 M\ T^{-2}$
Elect. resistance.....	$L^{-1} T$		$L T^{-1}$	$L^2 M\ T^{-1}$
Elect. capacity..... ...	L		$L^{-1} T^2$	$L^{-2} M^{-1} T^2$

There are some very interesting analogies between the action of matter and that of electricity and magnetism. It has been pointed out by the writer (*Science*, Dec. 22, 1893), and no doubt by others, that matter possesses two entirely distinct properties, *i. e.*, attraction and inertia.* Thus, writing m for the dimensions of matter, considered from the standpoint of its attractive properties, and i for its

* As evidence that these have *not* hitherto been generally considered as distinct properties of matter, compare the statement made in most works on physics (for instance, Daniell, page 12), that masses are compared by weighing them against one another in a balance. Also see Tait and Steele's "Dynamics of a Particle," page 51, where it is stated that "the force with which the earth attracts a body is proportional to its mass. Gravity is not, like magnetism, for instance, a force depending on the quality as well as the quantity of matter" in a particle. See also the definition of mass, ibid, page 42. Had it not been for the discovery of the bodies, iron, nickel, cobalt and platinum, we should have supposed that quantity of magnetism was always proportional to quantity of magnetism. Text books on physics would then have contained the following definition, as a parallel to that given for mass in "Dynamics of Particle": "The quantity of electricity on a body, or the magnetism, is proportional to the force with which the body is attracted to a unit quantity of electricity, when placed at unit distance."

dimensions considered from its property of having inertia, and a and l for the dimensions of two properties of the medium, we have,

I. $bb/L^3\mu - mm/L^3 a = qq/L^3 k, = ML^2 T^{-1}$

This leads us to a very simple proof of Maxwell's celebrated formula. For, from I. we get,

J. $ML^3 T^{-2} = m^2 a \quad L^{-1}$ and

K. $b^2 T^{-2} a = m^2 T^{-2} \mu$

Also we know from experiment that the energy of a condenser is $1/2\ V^2 C$, which equals $(dB/dt)^2 \times C$. And therefore the dimensions are $b^2 T^{-2} kL$, which must equal the dimensions of work, $m^2 a^{-1} L^{-1}$, or,

L. $b^2 T^{-2} kL = m^2 a^{-1} L^{-1}$.

Therefore $aT^{-2} \div KLT^{-2} = \mu T^{-2} \div a^{-1} L^{-1}$.

Whence we have Maxwell's equation,

B. $k^{\frac{1}{2}} \mu^{\frac{1}{2}} = T/L$.

We may now follow the analogy out much further, and show that the ratio $a \phi l$ must also be a velocity.

Experiments with Electric Waves.

BY ALFRED G. DELL.

In an arrangement of sheet zinc similar to the one described in The Electrical World of May 4, 1895, the four plates were made 8 x 10 inches in size, and the brass wires running to the spark gap so arranged that the plates could be shifted any distance apart from six inches to two feet. To the plates were attached two parallel copper wires, the other ends of which were fastened to the electrodes of a Geissler vacuum tube seven inches long. With a bridge wire across the two parallel wires, the nodes at which the tube lights up were found and all the different phenomena noted for a distance of two feet apart. The plates were then gradually moved nearer to the spark gap, and it was found that the nodes did not change their distance, nor were there any changes in any of the phenomena. Everything was entirely independent of the distances of the plates from the spark gap, the position of the nodes seeming to depend entirely upon the length of the two parallel wires.

When a Ruhmkorff induction coil is discharged through a Geissler tube, one of its bulbs is partially filled with light and the other one with a glow. I shall designate the former as the positive and the latter as the negative in the description of the following experiments.

Two sheets of zinc, 2 x 3 feet each, were placed with their planes inclined to each other; an edge of each one was attached to an electrode of a Ruhmkorff induction coil, and a wire fastened to the opposite edges so that the sparks could be caused to pass. Between the plates was placed a Geissler vacuum tube, each end of the tube being about six inches from the adjacent plate, the arrangement being similar to the figure /—\; the tube was not in any way connected with the coil. On turning on the current, the tube lighted up, and on moving the wire at the other ends of the plates, it was found that the tube remained lighted and increased in brightness when long sparks passed, but as soon as the sparks became shorter and lost in part their loud snapping noise, the tube became entirely dark. The tube was then placed nearer the plates, when it was found to hold its light a little longer; on shortening the spark gap, however, it again became dark. An earth connection was then attached to the electrode of the tube situated on the positive side, when the corresponding bulb became nearly empty and the other one filled with light. On reversing the current, both bulbs became filled with light.

One of the 2 x 3-ft. plates and the tube were then removed and the positive electrode of the coil attached to the remaining plate so as to connect or spark to earth from the negative electrode; with a new incandescent lamp bulb placed with its apex turned toward the plate, the different effects produced on the light in the bulb by using the ground connection were investigated.

It was found that when the bulb was about six inches from the plate it lighted up and that upon making earth connection at the negative end of the coil it increased in brightness as soon as the sparks commenced passing; when connection to earth was completed, it became very bright, but when the bulb was moved further away from the plate, the light went out when there was no earth connection, but lighted up when the earth connection was re-made. On reversing the current, the bulb would light up when it was very close to the plate, but dimly, even when the positive electrode was connected to earth.

For the incandescent bulb there was substituted a resonating circle with its plane perpendicular to the 2 x 3 feet plate, and upon adjusting the spark gap of the circle (the positive end of the coil being attached to the plate and the negative to earth and with no sparks in the secondary of the coil) flashes of light were obtained in the spark gap. On placing a finger on the wire of the circle a constant light was obtained at the spark gap, and also at the point where the finger touched the wire. I immediately recognized the same condition that was encountered in working with a pair of parabolic reflectors described in The Electrical World of Feb. 23, in which case, however, the spark gap of the receiver was outside of the field of force, while in this case it was within the field.

A circle was next used, two feet in diameter and made of two wires, each about three feet long, the break being made in the other end of the diameter containing the spark gap; to one of the wires a piece of sheet zinc about 1½ by 7 inches was connected. With this arrangement brilliant and steady sparking was obtained when near the zinc plates without any earth connection with the coil. When placed at such a distance from the zinc plate that sparking ceased as soon as the earth connection was made at the other electrodes of the coil and when sparks commenced to pass to earth, it lighted up, becoming very bright upon making the earth connection. It appeared to spark in nearly all positions of the circle, but not when placed perpendicularly to the zinc plate, with the sparking gap facing the plate; it also seemed to spark equally well with either end of the coil connected to the earth.

The experiment is novel and a beautiful one. Sometimes the spark seemed to scintillate and throw out rays of light, and it was interesting to see it flash up when the ground connection was made.

When the positive side of a Ruhmkorff induction coil is connected to a pointed wire and the negative to a small plate, the sparking distance is greater than when the negative is connected to the wire and the positive to the plate, the sparks passing between the pointed wire and the flat surface of the plate. When the positive is connected to the 2 x 3 feet zinc plate and the negative sparks to the earth, the sparking distance is greater than when the negative is connected to the plates and the positive sparks to the earth.

The Governing of Steam Engines.

A correspondent in the London *Electrician* criticises the method proposed by Mr. G. Addenbrooke (see The Electrical World, May 11), for the regulation of the voltage of a compound dynamo by the governor of the engine instead of by a resistance in the shunt. This arrangement, he states, may be very good for a single unit of plant, as a voltmeter connected across the dynamo terminals would enable the engine attendant to adjust the governor as required. But with two or more units running in parallel, how, he asks, is the engine attendant to know how the load is divided, and which engine governor requires adjusting? "Surely the switchboard attendant is the proper person to regulate the voltage. A glance at the ammeters in circuit with the dynamos would show how the load is divided, and with the shunt resistances close at hand both current and voltage can be varied to suit requirements."

In reply Mr. Addenbrooke says he did not advocate the running of compound dynamos in parallel, but merely spoke of a compound dynamo in one instance, as it happened to be coupled to the engine on which the governing experiments were tried. As to how the engine driver is to know how the load is divided, Mr. Addenbrooke asks, "How is an engine driver to drive engines to the best advantage if he does not know what work they are doing?" In the case proposed, the dynamo ammeters and voltmeters would be situated near the engine driving each, and under observation of the driver, who would then know exactly what he was doing. He would also know the extra voltage required as the load increased, and therefore could keep his engines properly loaded, and adjust them as required to the best advantage. The duty of the switchboard attendant is to look after the circuits in a central station, and he should not have his attention divided by having to superintend running engines also, a duty for which he is often unfitted. He will have a main voltmeter and ammeter on the omnibus bars, so that he can judge the state of matters, and he can, of course, signal to the driver. With this arrangement Mr. Addenbrooke thinks the use of resistances can be almost dispensed with.

Gas Engines in a Central Station.

A NUMBER of attempts have been made in Great Britain to utilize gas engines with commercial success in central stations, notably at Bridlington, Coatbridge, Morecambe, and recently at Belfast. The failure of the system at Coatbridge served to somewhat check the movement in favor of gas engines, although the unsatisfactory results in this case cannot reasonably be attributed to the engines, for it is pretty well understood that the difficulties arose from the attempt to run alternators in multiple. At the Morecambe station the use of water gas in the engines, it is reported, has caused some annoyance.

The station at Belfast, Ireland, however, gives promise of better results. This plant, which was installed by the municipality according to plans prepared by Prof. Kennedy, is located almost exactly in the centre of the city, and has already about 8,000 incandescent lamps connected.

Viewed from the exterior, the station building presents an unusual appearance as compared with a steam plant on account of the absence of any boiler room, stacks or chimney. It is long and narrow and looks like almost anything else than an electric light station.

The electrical equipment consists of four bipolar dynamos of 57½ kilowatts capacity each, two smaller dynamos of 26½ kilowatts capacity each, and 126 cells of accumulators, of the 34-K, E. P. S. type. The dynamos are rope-driven, the larger ones by tandem cylinder, double-acting engines and the smaller by single-cylinder, double-acting engines. Fig. 1 gives a partial view of the interior of the station and shows the position of each dynamo with relation to its engine. The engines run "under" so as to put the slack of the ropes on top. Unusually good regulation is obtained, owing to the fact that there are two impulses for each revolution, the active period of one cylinder alternating with that of the other, which feature places these engines on equal footing, in this particular, with the steam engine.

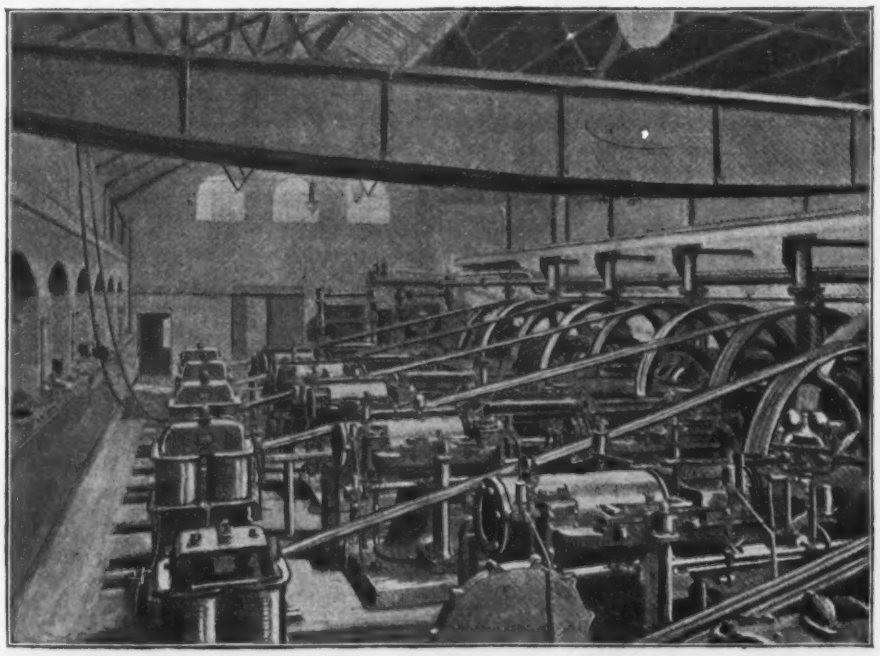


FIG. 1.—DYNAMO AND ENGINE ROOM.

A special governor was designed for the engines, by means of which regulation is obtained by varying the power of the impulses, down to a low limit, when further diminution of power is caused by cutting out the charges, one at a time, until the engine runs idle.

The consumption of gas is said to be very low, the statement being made by the builders that at an official trial of a tandem engine, extending over six hours, at full load, the gas used was somewhat less than 24 cubic feet per electrical horse-power, or about 21 cubic feet per brake horse-power at the engine pulley. During this trial the main fuse blew, but so well did the governor handle the engine that there was no sign of racing, a very slight increase of speed being the only result.

Gas is delivered practically from the street mains directly to the cylinders, passing through meters on the way. The main gas pipe is connected to the engines exactly as a steam supply pipe would be, a branch pipe leading off to each engine. The gas for the ignition tubes, however, is taken through a separate pipe and is measured by a special meter. Water for the cylinder jackets is obtained from a tank, and circulation is maintained by a small centrifugal pump under each engine. The speed of the engines is 160 revolutions per minute.

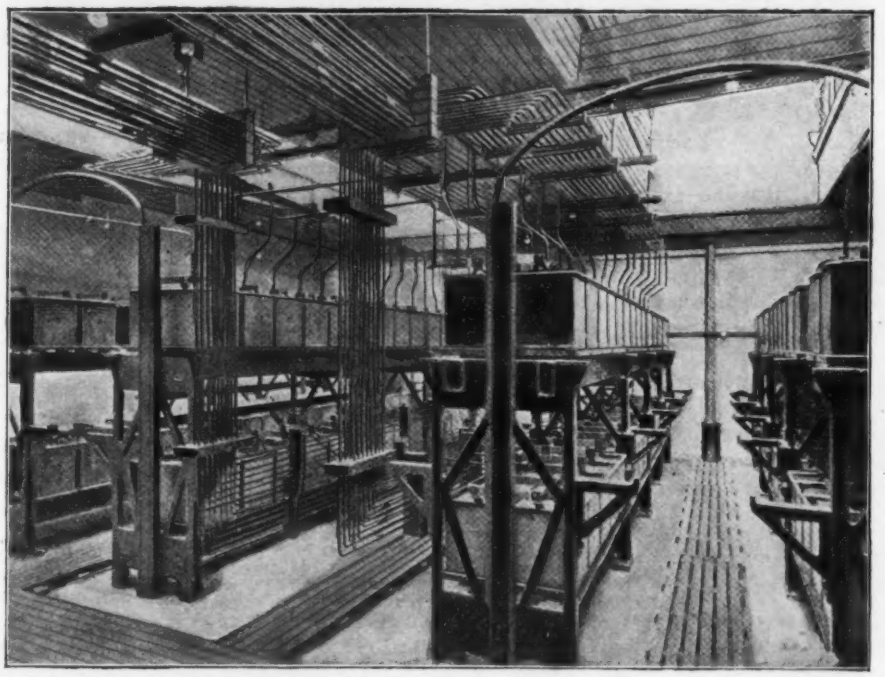


FIG. 2.—ACCUMULATOR ROOM.

There is nothing special or novel in the construction or operation of the four large dynamos. They are plain 230-volt machines and are driven each by eight ropes, seven-eighths inch in diameter, at 600 revolutions per minute.

The two smaller machines are special both as to construction and functions. Each armature has two distinct windings and commutators, and the brush cables are led to a switch by means of which the windings are connected in series for an output of 250 volts and 100 amperes, or in parallel for 125 volts and 200 amperes. The field winding is in shunt to one pair of brushes. These machines are used for charging the accumulators and balancing the two sides of the three-wire system.

The gas engines are started up in a rather novel way, each dynamo acting as a motor to start its own engine, the necessary current being furnished by the accumulators. When the proper speed is attained an automatic switch disconnects the dynamo (running as a motor) from the accumulators.

The batteries are divided into two sets of 63 cells each and regulation is effected by an automatic device which places cells in parallel to reduce the E. M. F., as opposed to the old method of cutting them out entirely. Fig. 2 gives a view of the accumulator room. The accumulators are used to handle the day load and in starting the engines, as above described.

The switchboard is divided into panels and all the negative terminals are led to one side of the board and all the positive ter-

minals to the other. The automatic devices above referred to are mounted on the switchboard, along with the usual quota of voltmeters and ampere meters.

In the distributing system a good deal of care and skill has been necessary to overcome the obstacles imposed by the peculiar conditions of the soil. For the most part bare copper conductors have been adopted, though unde the roadways Callender's cable is used as well as in some of the narrow streets. A concrete trench is employed, inwh ich the bare copper mains are laid. Owing to the extremely wet nature of the soil, a most careful system of inspection has been organized; the box covers are provided with inspection plugs which, when taken out, allow the men, who are sent round every morning, to pass in a pole and thereby ascertain the height of the water.

The above data and illustrations were taken from the columns of the London *Electrical Review.*

Contribution to the Theory of Demagnetization.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

It has long been known that in order to retain the magneti-m in a permanent magnet of hard steel, certain relations must be maintained between length and cross section of the bar as compared with the dimensions of the air gap between its poles. In other words, it has been known that a certain proportion of the reluctance of the magnetic circuit must exist in the air gap for a given value of the retentivity or hysteretic coefficient in the steel employed, in order that the magnetic flux in the circuit should be permanently retained.

Mr. Hookham states in the *Philosophical Magazine* for 1889, vol. 27, pp. 187-189, that, from his observations, the ratio of length to cross section in a magnet should not be less than 70 times the ratio of length to cross section in its air gap, in order to retain its magnetism indefinitely.

So far as the authors are aware, the theory of demagnetization in permanent magnets has not been developed except in a few geometrical forms of magnets, such as ellipsoids, which rarely present themselves in practice. It is here proposed to present this theory of the demagnetization of steel horseshoe magnets in a general form, and to show the relation existing between this theory and Mr. Hookham's empirical rule.

In Fig. 1, *A*, *B*, *C*, represent a horseshoe magnet of hard steel, l cms in length, and of uniform cross-sectional area s, sq. cms. Fig. 2 represents a portion of the descending curve in the hysteretic cycle of this steel. When the ring is magnetized, by the application of a M. M. F. to an intensity of, say, 6,000 gauss, and the M. M. F. is withdrawn, a certain residual intensity of $\mathfrak{B}$ gausses will exist in the bar, and the total residual flux will be $\Phi = \mathfrak{B}\, s$ webers. Of this residual flux, a certain fraction Φ/n, or, say ϕ will pass through the air gap, whose width is d cms, and active cross section S sq. cms., producing in the air gap an intensity of ϕ/S gausses. The remainder of the flux or $\Phi - \phi$, webers, will pass through leakage or air paths outside the air gap.

Just as in the electric circuit, a current of i amperes, passing through a resistance of r ohms, produces a difference of potential of $e = ir$ volts, so a flux of ϕ webers passing through a reluctance $\mathfrak{R} = d/S$ oersteds, in the air gap, will produce a difference of magnetic potential of $\mathfrak{M} = \phi\,\mathfrak{R} = \frac{\phi\, d}{S}$ gilberts. The mean difference of potential per centimetre length of the ring *A*, *B*, *C*, will be $\mathfrak{H} = \frac{\mathfrak{M}}{l} = \frac{\phi d}{Sl}$ gausses, and this will be the mean demagnetizing force exerted through the bar. The effect of this demagnetizing force will be to reduce the flux through the bar until the residual intensity $\mathfrak{B} = \frac{n\phi}{s}$, is the intensity which corresponds in the descending branch of the hysteretic cycle to the demagnetizing force $\mathfrak{H}' = \frac{\phi d}{Sl}$. As soon as the residual flux descends to this intensity, equilibrium will be reached. The equilibrium, however, is unstable, for any mechanical agitation or variation of temperature to which the bar may be subjected in the presence of this demagnetizing force will cause a further demagnetization to take place. In order, therefore, that a magnet should not be liable to variations in its intensity, owing to slight accidental jars or variations of temperature, it is necessary that the demagnetizing force $\mathfrak{H} = \frac{\phi d}{Sl}$ should be considerably less than the value of $\mathfrak{H}$, which corresponds to the residual intensity $\mathfrak{B} = \frac{n\phi}{s}$ in the descending curve of the cyclic diagram for the quality of steel employed. The ratio of the cyclic value to the actual value of $\mathfrak{H}$, may be called the *factor of safety of demagnetization.* According to the experiments of the authors a reliable factor of safety is 3, and this factor of safety can usually be provided by proportioning the length and cross section of the magnet and of the air gap with reference to the hysteretic curve of the steel employed.

Suppose, for example, that an air gap has to be provided 0.5 cms in width, and 10 sq. cms in active cross sectional area. Let the desired residual intensity in the steel be 1,500 gausses, and in the air gap 600, also let the assumed value of the leakage factor $n = 1.3$, and *D*, *E*, *F*, Fig. 2, be the descending curve of magnetization for the steel employed. Then the flux $= 1{,}500\, s = 600 \times 10 \times 1.3$, or, $s = 5.2$, so that the cross section of the magnet must be 5.2 sq. cms.

The cyclic value of $\mathfrak{H}$, which corresponds to $\mathfrak{B} = 1{,}500$ is 26, so that with a factor of safety of 3, the value required is 8.7. The M. M. F. in the air-gap will be $600 \times 0.5 = 300$ gausses, and the mean $\mathfrak{H} = \frac{300}{l} = 8.7$, so that $l = 34.4$. The length of the ring must, therefore, be 34.4 cms. When an intensity is set up in the bar of, say, 6,000 gausses under the magnetizing M. M. F., a powerful counter M. M. F. would tend to be set up on its withdrawal. If, for example, 6,000 gausses remained in the bar. the intensity in the gap would be 2,400, and the demagnetizing force 34.8. Reference, however, to Fig. 2, shows that such a demagnetizing force, if sustained, would reduce the residual intensity to about = 750, at which the cyclic demagnetizing force would only average 4.35 gausses. It is evident, therefore, that the intensity would fall along the line *D*, *E* *F*, until equilibrium is reached between the intensity and demagnetizing force. This would be met under the assumed conditions as

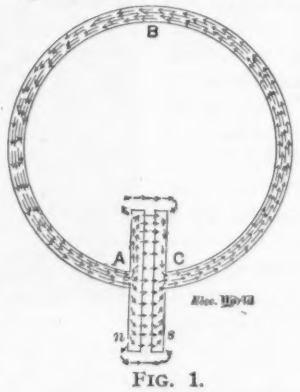


FIG. 1.

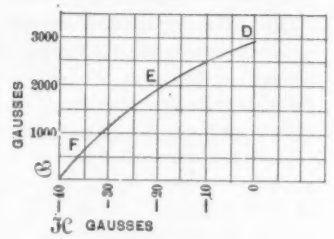


FIG. 2.

$\mathfrak{B} = 2{,}250$, approximately. That is to say, if the magnet were allowed to assume its natural condition, the intensity in the steel would fall to about 2,250 gausses, and the demagnetizing force rise to about 13 gausses, and this condition would be unstable, being probably followed by a slow and gradual decline in intensity under mechanical or thermal agitation. The process of seasoning a magnet consists, therefore, in designedly lowering its intensity below the natural intensity of equilibrium, so that the residual demagnetizing force may then be too small to precipitate further demagnetization even when aided by considerable mechanical or thermal disturbance. Thus, if the magnet be boiled in water or oil, or its air gap be momentarily widened, or if it be violently agitated, the intensity may be reduced to 1,500 gausses, with a corresponding demagnetizing force of 8.7, which is three times less than the cyclic force required to reduce the intensity still further.

If the magnet is not properly designed, it will, after seasoning, be either unnecessarily heavy for the work it has to perform, or unduly weak in residual intensity.

$$\text{Since } \mathfrak{B} = \frac{n\phi}{s} \text{ and } \mathfrak{H} = \frac{\phi\, d}{S\, l}$$

$$\frac{1}{n} \cdot \frac{\mathfrak{C}}{\mathfrak{H}} = \frac{l}{s} \Big/ \frac{d}{S}$$

So that if $\mathfrak{B}$, the residual intensity, be given an assigned value, $\mathfrak{H}$, defined as being, say, one-third of the cyclic value corresponding thereto, bears a fixed ration to $\mathfrak{C}$, and $\frac{1}{n} \cdot \frac{\mathfrak{C}}{\mathfrak{H}}$ is for magnets of the same form and material a definite numerical quantity, which is the ratio of l/s in the steel to d/S in the air gap.

According to Mr. Hookham's formula, this ratio should not be less than 70. If we make the assumption that the intensity in the steel he employed was 2,000, that it was powerfully magnetized at the outset, and that n was 1.3 in his magnetic circuit, then $\frac{1,000}{1.3\,\mathfrak{H}} = 70$, or $\mathfrak{H} = 11$ approximately, while the cyclic value of $\mathfrak{H}$ corresponding to $\mathfrak{B} = 1,000$ is 33 gausses, giving a safety factor of three.

In the well-known Weston permanent magnet ammeters and voltmeters, the accuracy of the instrument depends upon the permanence of the conditions existing in the magnetic circuit. The length of a particular Weston horseshoe magnet is 27 cms, its cross sectional area 2.7 sq cms. There are two air gaps in series, each approximately 0.275 cm long, and 11 sq cms. in active cross section, offering, therefore, a total reluctance of approximately 0.05 oersted. The intensity in the steel is approximately 1,250 gausses, and the total useful flux through the air gap 2,500 webers, making the total C. M. M. F. $2,500 \times 0.05 = 125$ gilberts, and the mean demagnetizing force $\frac{125}{27}$, or nearly 5 gausses. For steel with a cyclic curve represented in Fig. 2, this would represent a factor of safety of 6, and the well-known satisfactory permanence in the magnetism in these instruments is, no doubt, owing to a large magnetic safety factor.

A Recent Supreme Court Patent Decision.

BY GUSTAV BISSING.

The Supreme Court of the United States, speaking through Mr. Justice Brown, has recently handed down a decision (Ridson Locomotive Works vs. Medart) in the case of a mechanical process which has resulted in a wide difference of opinion as to its proper construction and interpretation. The process before the Court related to the manufacture of pulleys and consisted in, first centering the pulley centre or spider; second, grinding the ends of the arms concentrically with the axis of the pulley; third, boring the centre; fourth, securing the rim to the spider; fifth, grinding the face of the rim concentric with the axis of the pulley; sixth, grinding or squaring the edges of the rim. It was held that the process was not patentable. If this opinion is to be taken as holding that the process in question involves merely the skillful use of perfected machinery in a workmanlike manner, it expresses no more than the application of well understood principles to the case in hand, and need give us no concern. If, on the other hand, the opinion holds that no purely mechanical process which is executed by machinery is patentable, it is evidently of wide reaching importance and materially restricts the field for invention. It is not believed that the decision can be made to bear the latter interpretation.

The opinion begins with a statement of the process in controversy and of a few general considerations which will hereafter be referred to. It then subjects to analysis some of the leading Supreme Court cases in which patents for processes have been sustained and finds a mark which is supposed to be common to all, namely, that such processes were either chemical or else consisted in the use of one of the agencies of nature for a practical purpose. It proceeds to discuss two Supreme Court cases in which patents for processes have not been sustained and finds in effect that these processes covered "nothing more than the operation of a piece of mechanism or, in other words, the function of a machine." So far there is certainly nothing harmful to patent interests, and much less anything of a revolutionary character. But it is insisted by some that the decision covers more than this; that it holds in effect that it is *necessary* for a patentable process to be either chemical or else to consist in the use of the agencies of nature for a practical purpose, and that any purely mechanical process which can be executed by mechanism, or which must necessarily be executed by mechanism, is necessarily for the function of the machine and hence unpatentable.

But it is not thought that the decision can be thus construed. First of all, it is one thing to find a certain mark common to all processes which have been found patentable in the past and quite another thing to predict that this mark must necessarily attach to any patentable process which may be discovered in future. Such conclusion would directly contradict fundamental and well settled principles of inductive logic. It is not sufficient to find a certain mark common to a certain class of phenomena in order to predicate such mark for all future phenomena of the same class. It is necessary in addition that this common mark should appear as sound and reasonable in itself from entirely à priori consideration.

Thus, if we found five men in a street car, all of them suffering with strabismus, this would not give us the slightest warrant to infer that the next man who entered the car would be affected in the same way. Or, to use an illustration of a professor of inductive logic, whose lectures the writer had the pleasure to attend, if we should select the first five poets from a biographical dictionary and find that their ages were all divisible by three, this is no possible reason for asserting that the age of all poets is a multiple of that number. The fact is that each object or phenomena in a group of objects or phenomena has an infinite number of marks or characteristics, and it is a mere question of probabilities to find how many of such marks are common to all the objects of the particular group which we have selected. It furnishes no reason for supposing that another object or phenomena added to the group will have any one of such marks. When, therefore, the Justice found, if so he found, that all processes which had previously been declared patentable by the Supreme Court were either chemical or consisted in the use of one of the agencies of nature for a practical purpose, he could not have intended more than to call attention to an interesting and possibly instructive fact; he could not be supposed to declare that as a matter of law all patentable processes must of necessity be of the same nature, that they must have this same mark, unless he believed that such mark was, in the nature of things, and, from à priori and fundamental considerations, sound and proper.

But it does not appear that this mark or characteristic to which we have referred is sound and proper or that the learned Justice thought it so. It does not appear, in a word, that he considered it as a criterion. First of all, let us examine processes from their philosophical and scientific aspect. They consist of an act or a series of acts, that is, they consist in the manifestations of energy upon matter. The proposed criterion, if it is to be a criterion at all, and if it is to be construed as necessarily excluding purely mechanical processes which are the operations of pieces of mechanism, would attempt to distinguish between the manifestation of physical energy in certain forms and of physical energy in other forms. It would pretend to include the manifestations of energy when in the form of electricity, as found in the telephone and telegraph cases; when in the form of heat, as found in the tempered car wheel case; when in the form of a blast of air, as in the flour-bolting case, all of which were quoted with approval by the Justice; and it must also include the case of energy in the form of centrifugal force as appears from the centrifugal casting case which was sustained by the Supreme Court as being for a valid process and has not been overruled. Such criterion, on the other hand, would pretend to uniformly and necessarily exclude the manifestation of energy when in the form of vis viva or impact, as in a drop hammer, and when in a form developed by any other purely mechanical tool.

That such distinction cannot be maintained on philosophical grounds seems reasonably clear. Your Hume, Kant, Hegel and Locke have written much upon the nature of the different forms of energy and force, but it is not pretended that they have found any fundamental or philosophical distinction between them. The fact is that elementally we know as little about the ultimate nature of impact as we do about the ultimate nature of electricity. Nor can the scientist or technical man draw any hard and fast line between the different forms in which energy manifests itself. The expert physicist knows as much about heat and its laws as the expert engineer knows about impact and the strength of materials. There is a gradual merging of one type into the other, and the more we learn, the more we are led to suspect a common origin for all forms of energy and a common rule by which all can be subjected to calculation. It is hardly more than a question of the order in which we shall take them up for study. Some are treated early in books on physics, some come later on; but they are all recognized as branches of one and the same subject. The philosopher knows as little, the physicist knows as much, about one as about the other.

It seems clear, therefore, that if Mr. Justice Brown intended the statement that the patentable processes discussed in the opinion were either chemical or consisted in the use of the agencies of nature for a practical purpose as a definition of the necessary characteristics which all patentable processes must have, and as a criterion by which the jurist might distinguish between such processes as are patentable and such as are not, he did not base his action on any philosophical or scientific considerations. The fact is that he did not consider it even necessary to emphasize sharply the distinction between chemical phenomena, in which the constitution of the molecule is changed, and physical phenomena in which each molecule itself remains unaltered, although its relation to other molecules may be changed, for he gives, without remark, as a "chemical" effect

the case of the tempered car wheel in which the cooling is retarded by a second application of heat. If, then, for the purposes of the decision, a sharp distinction between chemical and physical phenomena was not considered as necessarily important, it would certainly be somewhat venturesome to accuse the learned Justice of attempting to establish a sharp line between several classes of phenomena, all of which are purely physical. It is certainly unreasonable to suppose that we are to have the sword of the Arabian Nights hewn between the members of the body constituting physical science, and that chemistry and physics are to be left undivorced. If, then, any basis for the criterion which it is supposed has been set up is to be found, it cannot be in science; it must be in law.

Now, the Constitution of the United States merely provides that Congress may protect "inventors," and the Statute made in pursuance of this provision gives to any person who has "invented" or "discovered" a new and useful art or any new and useful improvement thereof the right of patent. It follows, then, that both the Constitution and the Statute make the "invention" of a new and useful process the test of the right of patent. If the courts have held that purely mechanical processes can never be patentable, it must be either because they have determined that mechanical processes can never involve invention or because they have imposed a narrower meaning on the word art than is given it in common usage, and this for the mere purpose of crowding out certain new and useful inventions without any stated reason of public policy. Since, however, the tendency of the courts has uniformly been the other way, in the direction, in fact, of construing the words art, machine, manufacture or composition of matter in their broadest sense to include all inventions of whatever kind, even if they do not apparently fall within the letter of the Statute, it is only reasonable to conclude that if certain processes have been declared unpatentable it was not because they did not come within the meaning of the term "art" as used in the Statute, but because they did not involve invention, as processes. Whatever may have been the language in which the various decisions have been couched, there is nothing in them to negative the presumption that if the process in controversy as a process involved that peculiar kind of novelty and utility which is called invention, that is to say; if the novelty and utility and invention in their real essence resided not in the machine which may have been devised to execute the process but in the process as such, the patent therefor may be sustained. The question of invention in the process as a process is the test.

There have been before the courts a number of processes in which there has been no merit or invention in the process as such, but rather in the machine which has been devised to execute it. Such processes, to use the language of Mr. Justice Brown in the decision under discussion in this paper, "involve nothing more than the operation of a piece of mechanism," that is, they involve the mere operation of the useful mechanism with no meritorious or inventive idea beyond the mechanism; or, again, they "consist solely in the operation of a machine," that is, they consist in the *mere* operation of the machine; and such processes, which as processes involve no inventive idea beyond what is found in the machine which executes them, have been called functions of the machine. But the fact that processes of this type have been declared unpatentable does not for a moment prove, or even indicate, that any other test than that of invention in the process *per se* has been set up. On the contrary, Mr. Justice Brown expressly states that "there is somewhat of the same obscurity in the line of demarkation (between patentable and unpatentable processes) as that between mechanical skill and invention."

In a word, processes which are purely mechanical come within the natural meaning of the term art as used in the Statute. If they are not to be considered patentable in any conceivable case, it must be either because the Supreme Court has placed a narrower meaning upon the term "art" than dictionary usage justifies, or because it has been declared that no mechanical process as such can even involve invention. The first alternative, however, is not to be presumed. It is directly counter to the uniform policy of the Court in protecting meritorious inventors independent of any merely technical questions. It follows, then, that the criterion which Mr. Justice Brown is said to have set up must mean that no purely mechanical processes, as a process, can ever involve an inventive idea.

This, however, accuses the learned Justice of a desire to assume the role of a prophet. It also accuses him of a slip in logical method, for, as pointed out above, the fact that the five cases of processes involving invention discussed by him were either chemical or consisted in the use of one of the agencies of nature for a practical purpose, and that the two Supreme Court cases of processes not involving invention especially relied on (Wyeth vs. Stone and Corning vs. Burden) were both purely mechanical, is no reason why every purely mechanical process which may in future be discovered shall not involve invention, and hence be unpatentable. This fact of experience, if it be a fact, which is denied, may instruct us about the inherent probabilities of the cases, but it can not and does not lay down a rule. It is doubtless true that purely mechanical processes, being usually for the mere manipulations of well known materials by methods and tools well known to craftsmen, very rarely involve inventive ideas in the processes. It is an abuse of the law to attempt to cover such every day manipulations by process claims. The invention in the very large proportion of cases lies in the apparatus which has been devised to execute the process. It does not lie in the process. But to say that the invention in cases of purely mechanical processes can never lie in the process is an obvious nonsequitur, and to say that the Supreme Court will not protect arts because they happen to belong to the class of mechanical processes, whether they involve invention or not, has no warrant in decision or reason.

Let us take for illustration the case of an old paper bag which has before been made by creasing, folding and pasting the paper by a dozen or more successive steps. It is found that by merely holding the old paper blank in the hand in a new way and making a change in the manipulation, it can be converted by the fingers into the same completed bag by *two* successive steps. Let us suppose, to strengthen the argument, that such a process had long been sought, and that when attained, it had largely replaced other bag-making processes. Here obviously is an invention. It is not a new composition, certainly, nor a new article of manufacture, whether bag or blank, nor a new machine. If it cannot be protected as an art or process, the inventor has no protection Now, it will not be denied that so far as the present description of the process has gone, there is nothing in Mr. Justice Brown's opinion holding it unpatentable. This opinion merely refers to processes which involve "nothing more than the operation of a piece of machinery," or processes which consist "solely in the operation of mechanism" and no machinery or mechanism has yet been used. But let us assume further that our inventor, after having successfully practiced his process on a commercial scale by hand operators for a number of years, invents a machine, a bag making machine, for carrying out the same process. Can it be supposed that this future act of his annuls his right to a patent for a process attained by his former invention of the process, or that it vitiates his patent for the process if already granted? Yet the writer has heard those skilled in patent matters declare that such is the effect of the decision with which we are dealing. Whatever the language of the decision may be, it must be clear that it was never intended to apply to such a state of facts. If the language seems to cover it, and the writer is not one of those who thinks it does, then such language must be interpreted in view of the specific case which the Supreme Court had before it. No decision is to be given an interpretation which will lead to absurdities, and especially not one by Mr. Justice Brown.

But it seems equally clear that there may be cases of processes involving invention in which the process cannot be executed by hand, but in which it necessarily requires a certain type of machine. As a well defined instance of processes of this kind, we may take the case of a loom for weaving linen. Let us suppose that a person discovers by running this machine at ten times its previous speed, and reversing the motion, if you please, that he can produce a most beautiful pile fabric in a manner entirely distinct from all other modes in which pile fabrics have been produced, and not in any way suggested by them. Add, further, the customary indicia of invention, a long-felt need and a revolution in the art. That this person has made an invention cannot be questioned. Since, again, it cannot lie in a composition or article of manufacture, and since it cannot lie in the machine, for the machine is the same whether running fast or slow, whether going forward or backward, the invention must lie in the process or the inventor loses protection. There may be those who suppose that the Supreme Court of the United States would throw out a patent for such an invention as this on merely technical grounds, because of a strained and narrow meaning of the word art as used in the Statute. The writer is not one of them. A court which has sustained the telephone process, which has always shown itself desirous of reaching the fundamental merit of a patentee's invention and of disregarding mere legal quibbles, technicalities and abstractions, may be counted on to sustain the patent of a real inventor for a real invention. If the

increased speed of the machine was sufficiently beyond the expected skill of the calling, if it was novel and unexpected in result, startling and useful in practice, it is clear that a patent for this means or process may be sustained, even though, in one sense of the word, it involves nothing more than the operation of mechanism, for, in another sense of the word, it involves a great deal more than this, namely, a great invention.

The fact that a patent for centering, trueing and finishing a pulley has been held invalid is, perhaps, a basis for holding that a mechanical process for squaring off the edges of a door and then fitting the door to the jamb may also be held invalid, but it is no reason for believing that a process really meritorious in itself, which involves more than the obvious skill of a carpenter or machinist, shall meet the same fate.

Specific attention may here be called to the fact that the flour-bolting case (Cochrane vs. Deener, 94 U. S., 780) was commented on and approved in the opinion delivered by Mr. Justice Brown. As it furnishes the most persuasive argument, perhaps, against the criterion which it is assumed has been set up—that all purely mechanical processes which may or even must be executed by machinery are necessarily unpatentable—it will repay a moment's investigation. The process invented by Cochrane consisted in passing ground meal through a series of bolting reels composed of cloth of progressively finer meshes and at the same time subjecting the meal to blasts or currents of air by which the superfine flour was separated and the specks and impurities were so eliminated as to be capable of being reground and rebolted. This process, it will be seen, consists in main of two steps, subjecting the material to the action of sieves and then to the action of a blast of air. Both of these actions are purely mechanical. They do not cease to be mechanical because they operate on comminuted material. A sieve is certainly a purely mechanical tool. A blower for producing a blast of air is an equally well-known mechanical tool, and was so recognized in the art of milling before Cochrane's invention. The process is, therefore, purely mechanical from beginning to end, and was so understood by the Court. Furthermore, Mr. Justice Bradley, who delivered the opinion in Cochrane vs. Deener, stated that "If one of the steps of a process be that a certain substance is to be reduced to a powder, it may not be at all material what instrument or machinery is used to effect that object, whether a hammer, a pestle, a mortar or a mill." Language could not be more clear to show that a purely mechanical process may be patentable. An example or illustration could not be more happily chosen to prove that hammers or mills, and by parity of reasoning, lathes and planers, are not necessarily excluded from the instrumentalities which may execute processes worthy of legal protection. Nothing can better indicate that in all processes it is not the instrumentality or machine for executing them which is to be considered, but the inventive ideas in the processes as such, whether they be executed by a hammer, by a mill, or by any other mechanical, hydraulic or electrical machine.

Another instructive fact appears from the Cochrane case. The machinery, in its broad and generic aspect, and so far as it was necessary for executing the process of the patent, was confessedly old. The patentee admitted "the prior use of currents of air in the interior of reels introduced by means of hollow perforated shafts for the purpose of keeping back the speck and increasing the quantity of superfine flour, but not for purifying the middlings preparatory to regrinding." An examination of his patent shows that his own machine, so far as it was necessary to carry out the broad process, consisted of hollow reels with perforated shafts therein for introducing blasts of air. The machine or mechanism was, therefore, old. The process alone was new, and it was sustained despite the fact that it was purely mechanical, as purely mechanical certainly as the hypothetical case set up above of the loom for weaving linen which turned out to be capable of manufacturing a pile fabric, and we have this conclusion strengthened by the consideration that the Justice who delivered the opinion referred to hammers, pestles and mills as proper tools for executing patentable processes. These considerations in themselves must show that Mr. Justice Brown, who had the case of Cochrane vs. Deener before him and discussed it, could never have intended to hold that purely mechanical processes are, *ipse facto*, necessarily, and in all cases, unpatentable.

A few words may, in conclusion, be said about that much abused phrase, "the function of a machine." What five words in patent literature have a more terrible sound? And what words have their meaning less understood? No sooner does a pleader find himself in the attitude of antagonizing a patent for a process than he remembers them as old friends and proceeds to wield them with delight. It is a hard case, indeed, into which they cannot be dragged. And yet the words in themselves, when properly understood, are perfectly harmless. If a process which is carried out by a machine involves no inventive idea in the process as such, irrespective of the machine, then the process is for the function of the machine; otherwise it is not. This is all there is to it. The phrase adds nothing to our knowledge; it describes a conclusion, not a cause; it gives us no criterion for determining the patentability of a process; it is merely a descriptive title applied to such processes as have, from entirely independent considerations, been found to be unpatentable. To attempt to use it for determining patentability is to turn logic upside down.

Rope Driving—XVI.

BY J. J. FLATHER.

It has been stated that a further decrease of from 5 to 8 per cent. of the power transmitted by a rope may be attributed to losses in the rope itself due to resistance to bending, wedging in the groove differential driving effect, and creep, all of which affect the loss to a greater or less extent. Various formulas have been proposed by several eminent authorities by which the resistance of a rope to bending might be determined.

Eytelroein's formula assumes that the resistance of a rope is directly proportional to the tension and the square of the diameter, and inversely proportional to the radius of curvature of the pulley; in which case the stiffness of a hemp rope for each winding and unwinding is given by

$$\sigma = C \frac{d^2}{r} T,$$

where C is a constant equal to 0.23, d is the diameter of rope in inches, r is the radius of pulley in inches and T is the tension in the rope. If the ratio of the diameter of rope to the diameter of pulley over which it runs equals 1 to 30, the above formula becomes, for a rope running over two pulleys:

$$\sigma = 0.03\ d\ T.$$

Reuleaux states that since transmission ropes are usually quite slack the coefficient of stiffness should be taken somewhat less than Eytelroein's value, and suggests that two-thirds would represent a fair approximation; this would give

$$\sigma = \frac{2}{3} \times 0.23 \frac{d^2}{r} T = 0.15 \frac{d^2}{r} T$$

for each pulley in the system.

If the tension on the tight and slack sides of the rope be represented by T_1 and T_2, respectively, the average load on the rope will be $\frac{1}{2}(T_1 + T_2)$; if, further, the conditions be assumed such that the slack side tension equals one-half that in the tight or driving side we shall have $T = \frac{1}{2}(\frac{3}{2} T_1)$; hence for two pulleys, when the diameter of the latter equals 30 times the diameter of rope,

$$\sigma = 2\left(\frac{0.15\ d^2}{15\ d} \times \frac{1}{2} \times \frac{3}{2} T_1\right)$$
$$= 0.02 d \times \frac{3}{4} T_1.$$

Since T_1 has been taken in our previous work as equal to $200\ d^2$ pounds, the stiffness in the rope will now become

$$\sigma = 0.02\ d \times 150\ d^2 = 3\ d^3.$$

Now under these relations of tension the driving force may be obtained from

$$P = T_1 - T_2 = 200 d^2 - \frac{200 d^2}{2} = 100 d^2;$$

hence the ratio of loss due to bending will be

$$\frac{\sigma}{P} = \frac{3 d^3}{100 d^2}.$$

For a ¾-inch rope running over two pulleys the loss equals 2.25 per cent., while for a 2-inch rope under similar conditions the loss becomes 6 per cent. This is what we might expect, for it is reasonable to suppose that the percentage of loss should increase with the diameter of rope.

It will be noticed that the work done in bending a rope over its pulley is directly proportional to the number of bends, and, therefore, in designing a rope transmission every effort should be made

to restrict the number of bends, as this is not only a large factor in the wear, but, as just shown, the power transmitted for a given tension is constantly reduced as the number of bends increase.

This feature is a decided disadvantage with installations on the continuous rope system where one rope is bent in both directions around a number of pulleys on the several floors of a factory.

Under such conditions, and also in those special cases where it is absolutely necessary to run pulleys smaller than 30 times the diameter of rope, the user should put in the very best quality of loosely twisted rope and run it at a less strain than would otherwise be adopted, for under such conditions the flexibility and elasticity of the rope are more desirable than a high breaking strength. While the foregoing formula of Eytelroein may give a measure of the force required to bend a rope over a pulley under a certain set of conditions, it will be evident since the conditions vary considerably in different installations that, in order to be generally applicable to any given case, a formula must contain other factors than those included in Eytelroein's and other similar formulæ.

In a flying rope running in *V* grooves, in addition to the bending of the fibres there is a permanent reduction in cross section due to the uniform compression of the rope, as will be noticed by measuring a rope that has been running some time; beside this there is a temporary deformation due to the distortion of the rope as it passes over the pulley. The flexibility and elasticity of the rope undoubtedly have much to do with the resistance to bending, and the degree of twist put into a rope is an important factor in this connection; for although hard-twisted ropes are very much stronger than those loosely twisted, the internal wear is much greater as the fibres are held more rigidly and do not slide as freely upon each other. The advantages of lubricating the fibres of a manilla rope have been already discussed; it is sufficient to state here that the degree of lubrication affects the flexibility of the rope, and hence enters as a factor in determining the loss due to bending.

The varying angle of contact, and to a lesser extent the angle of the groove, must also have a certain influence upon the resistance. In view of these considerations it will be seen that any deductions from existing formulas are of doubtful utility when applied to transmission ropes in use, and should be considered only as relative and not absolute.

Another source of loss is that due to the wedging of the rope in the groove. Although this action exists to a greater or less extent in all rope transmissions where the shape of the groove is such that the rope does not bottom, yet it is undoubtedly true that its effect in a well-constructed plant has generally been over-estimated. That it does exist to a harmful degree can be seen in many installations from the way in which the tight side of the rope follows up on the driven pulley.

With the single rope method this is especially true in new installations where the tension is purposely made rather high to allow for stretch in the rope; it is, however, frequently found in the continuous rope system where the tension carriage is over weighted. The factors which enter into the consideration of this loss are: tension on the driving and slack sides of the rope, the angle of groove, and the velocity, weight and condition of the ropes.

As we have previously shown[1] the driving side tension T_1 is made up of three parts, namely, the driving force, P, the centrifugal force, F_0, and the tension, T_2, necessary to balance the strain for adhesion; that is:

$$T_1 = P + F_0 + T_2;$$

in like manner the tension in the slack side of the rope consists of the strain necessary for adhesion plus the strain due to centrifugal force; that is:

$$T_2 = T_2 + F_0.$$

It has been claimed that no loss can occur in pulling the rope out of the groove since the centrifugal force set up in the rope is many times greater than any caused by the tension on the slack side when leaving the pulley, but it is obvious that a part cannot be greater than the whole, and, therefore, the centrifugal force, while greatly reducing the wedging force, cannot altogether eliminate it.

(To be continued.)

[1] See Electrical World, April 24, 1894.

Mathematics and Physics.

To the Editor of The Electrical World:

Sir:—In a recent editorial in The Electrical World on "Mathematics and Physics," a position was taken which, with all respect for the judgment of the writer, I beg leave to challenge—not that I object to the conclusion in itself, but to the manner of arriving at and applying it after being reached, and because the sentiments there expressed represent a growing tendency, both in the press and among so-called "practical men," that, if not hindered, must surely prove disastrous to the formative engineer.

A bright young "school" engineer was heard to say that he is actually ashamed to use a respectable scientific method for fear of being jeered by his comrades and perhaps dismissed by his old-school, slide-rule chief. But even in the schools there is a deplorable impatience in the study of pure mathematics. The student will hardly consent to anything that has not an immediate application.

The truth is that a first-class constructive engineer can be turned out in a year or two. In this day of tables, formulas, automatic instruments, etc., with a little common sense taken for granted, there is no reason why a person could not creditably execute any ordinary engineering specifications with that length of training. But the world is overstocked with that class of men already. The present demand is for *creative* engineers who can and will push out into entirely new paths and originate new methods, and the most versatile training is needed to produce these men. Hence the practice of to-day cannot be a test of the training for the future. Hence topics in mathematics must be studied that at present have no application.

One of the values of a technical education is found in the new ideas formed and these ideas need by no means have immediate application. If that were the test, a very large part of such subjects as thermodynamics, applied mechanics, etc., would have to be thrown out. The greatest present objection is the necessary meagreness of the mathematical courses in our technical schools. At present only the barest fundamental principles are taught and about all the examples are given from mechanics that can be. As a rule such applications require highly developed ideas at the start. The graduate does indeed forget many of the particular processes employed, but he will never lose the general ideas and methods of thought there acquired.

I admit the necessity for "flexibility" rather than "rigidity" in practical work. A great deal of practice must be merely approximation. But I maintain that all "flexibility" in method is extremely dangerous without a previous rigidity in the determination of what is the theoretical condition. It would be foolish to tell a workman to cut a wire *about* a yard long if he did not know exactly what a yard was. You must know the ideal before making a safe approximation. It is in the forming of this ideal that *pure* mathematics is indispensable. I cannot conceive how any one can maintain that "the rigorousness of mathematics leaves little field for the exercise of the imaginative faculty." There is no study in existence that more develops and necessitates this faculty than mathematics. It takes a great deal more imagination to succeed in mathematics than to write poetry. Indeed, without a highly developed imaginative faculty, no matter how great his reasoning ability, it is useless for one to attempt the study of the higher mathematics. The reason can only act when the material is well organized, and pictured to the mind.

There is no "drudgery" in mathematics when properly taught, and it is in the *methods* of *teaching* that at present fault should be found. As you conclude, the professor of mathematical physics is a growing necessity, but his work must commence where that of the pure mathematical courses now end and develop and apply the ideas therein imparted.

Charles Edwards.

New Orleans, La.

A Peculiar Phenomenon.

To the Editor of The Electrical World:

Sir:—On the night of April 26, 1895, a friend and myself were riding our bicycles through some of the irrigated country nine miles north of Lamar, and my attention was attracted by the electricity on the barbs of the wire fence. Next I noticed it on all metallic parts of our bicycles. There seemed to be a concentration at the hub when we rode fast, and when we rode slowly it scattered over the whole wheel. The electricity came up the fork, separated and traveled along the handle bars, going under the cork handles and sending a jet of electricity at least three inches beyond the end of the handles. I felt as though I had hold of an electric battery. This lasted about 30 minutes, leaving gradually. The ground was damp but not what might be called wet. I should be pleased if some of your readers would offer an explanation of this peculiar phenomenon.

T. A. Peplow.

Lamar, Colo.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

BY CARL HERING

COMPILED FROM THE PRINCIPAL FOREIGN AND AMERICAN JOURNALS

Note.—The object of this department is to give a digest of the principal technical articles on electrical subjects appearing in American and foreign periodicals. The abstracts will contain, briefly, the nature of the article, its object, and the most important data or conclusions, as far as the limited space will admit. Abstracts made by the authors, editors, or publishers are solicited and should be sent to the Philadelphia office of THE ELECTRICAL WORLD, 927 Chestnut street. They should be forwarded so as to be received at least as early as the journal in which the original articles appear; they should not be longer than the importance of the subject warrants, and must comply with the general outline given above, the compiler reserving the right to edit or reject them. Such abstracts may be sent in the English, French, or German languages. It will be to the advantage of all concerned if editors of non-electrical journals, or of such electrical journals as are not regularly abstracted, will send the compiler a copy, specially marked, in which any important electrical article appears.

DYNAMOS, MOTORS AND TRANSFORMERS.

Single-Phase Synchronous Motors.—The "Elek. Zeit.," April 25, contains a communication from Prof. Blondell in which he calls attention to a statement in the recent paper of Messrs. Bedell and Ryan (see ELECTRICAL WORLD, March 30), to the effect that Mordey was the first to announce the law that for a synchronous motor there is a certain value of the exciting current for which the armature curve is a minimum and the power factor a maximum; the present writer states that he annunciated this law a year previously to Mordey's announcement in "La Lumiere Elec.," 1892, where he also showed how to calculate this exciting current (vol. 45, p. 423 and 563); he also showed in that article that there is a value for the self-induction which will insure the maximum stability. He calls attention to the peculiar behavior of the motor used by Bedell and Ryan which is different from any that he has used. Regarding parallel coupling of alternators he says that experience with the transmission of power does not completely solve the problem, because in parallel coupling both machines are shunted by the external circuit; all alternators can be easily connected in parallel when not loaded, the difficulty arises when they are loaded, which reduces the relative values of the synchronizing currents; he believes to have shown, in the article referred to, that the ease of parallel coupling, for a non-inductive circuit, depends on the ratio of the current which each machine will give when short-circuited and that which they are to generate for the external circuit; he therefore does not include himself among those who believe the ideal will be found in the reduction of the self-induction; there is a limit below which one must not go but in practice there is no fear of reaching this limit. On account of the use of synchronous motors it is not allowable to reduce the armature reaction to a minimum.

Armature Reaction.—Referring to a recent paper of Bedell and Ryan in THE ELECTRICAL WORLD, March 30, the Lond. "Elec. Rev.," April 26, states that it is strange to see how people disregard the fact on which Mr. Sayers laid so much stress, namely, that his device is not designed simply to prevent sparking, as machines are built sparkless without it, but the advantages secured by his device are that the machines can be designed with iron imbedded conductors, minimum clearance, minimum exciting force and minimum weight and cost, at the same time securing absolute sparklessness.

Reversible Regenerative Armatures and Short-air-space Dynamos.—Mr. Sayers' Institution paper, which was abstracted in the Digest, March 16, 23, and 30 (also April 13 and 20), is published in full with all the illustrations and the discussion in the "Jour. Inst. Elec. Eng." for April.

Multiple Current Dynamos.—Mr. Rankin Kennedy in a communication to the Lond. "Elec. Rev.," April 26, refers to a statement in the serial by Mr. Wiener in THE ELECTRICAL WORLD in which he ascribes to Mr. Sayers the invention of the method of obtaining two or more currents of different voltages from the same armature (which consists in cutting deep wide slots parallel to the armature producing neutral points upon which intermediate brushes may be placed); Kennedy claims that this is a mistake as this method was patented to him April 4, 1892, English patent No. 1,640.

Continuous Current Dynamo.—An illustrated description of the 4-pole machine of Messrs. Balas and Couffinhal is given in "L'Ind. Elec.," April 25.

Dynamo and Motor Design.—A brief abstract of a recent lecture by Mr. Dunn is published in the "Jour. Frank. Inst." for May; the lecture was in many respects similar to the one by that writer which was abstracted in the Digest, Jan. 5.

Design and Construction of Dynamos.—A serial on "The Factory Practice in the Designing and Construction of Dynamos" by Mr. Woods, is begun in "Elec. Ind." for May; the present portion is somewhat elementary in character.

LIGHTS AND LIGHTING.

Search Light in the Japanese War.—According to the "Elec. Friend" (Japan) for March, the search light on the Chinese man-of-war in the battle of Wei-Hai-Wei formed a very good target for the Japanese torpedo boat.

Wilbrant Arc Lamp.—A brief description of this lamp is given in the Lond. "Elec. Eng.," April 26.

Train Lighting.—According to the "Amer. Eng.," "R. R. Jour.," for May, the Midland Railway of England has abandoned the electrical system of train lighting with which several of its trains have been equipped, on account of its unreliability and expensiveness; the efforts to perfect the system sufficiently to meet the requirements of the service were unavailing.

Stage Lighting.—The Mayrhofer system is described and illustrated in the "Elec. Eng.," May 8.

POWER AND HEAT.

Heating and Cooking.—A Society of Arts paper by Mr. Crompton is reprinted in the Lond. "Elec." and Lond. "Elec. Eng.," April 26, the latter containing also the discussion, apparently in abstract, and the illustrations; the "Elec. Rev." contains a short abstract of the paper. The application of electricity to heating and cooking has been regarded as impracticable and too costly; the object of this paper is to show that this is far from being the case and that electric heating and cooking has now advanced to a highly practicable and useful stage. He describes in detail the construction of the apparatus made by his company; they use nickle steel alloys which are much better than German silver and the enamel consists of two or more layers of different refractory characters, the wire is applied in the form of a crimped ribbon bent by a machine and transferred to the heated metal plates by means of a magnet. He describes his platinum thermometer (see below under instruments) by means of which measurements of the heat required in cooking were made with a high degree of accuracy and from this the amount of energy required for different operations; the results are given in a table in which the cost per kw hour is estimated as 8 cents; the following are some of the results: the cost of the energy required to raise a plate for roasting, baking, or frying to 400 degrees F. in 30 minutes is 3.62 cents; that for heating a radiator plate to 264 degrees F. (apparently in one hour) for warming the air of a room is 4 cents; that for boiling one pound of water in a tea-kettle is 0.64 cent. He claims that the opinions frequently stated that electrical heating is too expensive to become general, are based on an insufficient knowledge of the economy of cooking as generally carried on; the smallness of the results obtained by electrical methods are astonishing; the amount of heat actually utilized in cooking on the ordinary stove he found by experiment to be not more than 2 per cent.; the enormous waste, except when boiling water and stewing, is due to the fact that radiated heat is used; with a properly arranged griller heated electrically 65 per cent. of the heat energy is used in the meat; with gas cooking the percentage is not so striking but is still very favorable to electricity because the heat communicated to the food is by radiation from gas flames, the ventilating current carrying away at least 80 per cent.; with electric cooking the vessel is perfectly air-tight, no ventilation being necessary; in an oven fully 90 per cent. of the heat may be utilized representing 4.5 per cent. of the whole energy of the coal; thus the electrical oven is twice as economical as the ordinary oven. He refers also to the convenience and the superior results, the food in the ordinary method being frequently injured or dried up while the absence of the ventilating currents in the electric process prevents this and the facility for regulating the temperature is much greater. He sees no reason why in a few years a majority of the users of electric light will not do all their cooking by electric means using solid fuel only for boiling purposes. Regarding the heating of the Vaudeville Theatre he added that it was found that the electric radiators are convenient, safe and economical. The discussion, as abstracted, contained nothing of interest.

Polyphase Plant.—A long abstract of Mr. Boucherot's description of the lighting and power plant at the Weyher & Richmond works, is published in the "Jour. Inst. Elec. Eng." for April. An abstract of the original appeared in the Digest, Feb. 2; see also Jan. 26 and April 6.

Electrically Operated Canal Locks.—"L'Ind. Elec.," April 25, refers briefly to experiments which are to be made in Holland.

Crane.—A brief illustrated description of an odd form is given in "L'Elec.," April 27; it travels on a single rail on the floor and is guided by two rails on the ceiling.

New Science of Electrical Heating.—The "Eng. Mag." for May contains an article with this title by Mr. Hadaway; it is in favor of electric

heating under certain circumstances. In a good steam and electric plant 10 per cent. of the fuel energy can be secured in the electric current, and of the balance 35 per cent. is a direct loss, and 55 per cent. indirect; the latter can be utilized over limited distances. He suggests the term multi-potential thermo system for one in which electric energy is used as the "high potential heat factor," that is, for heating above 212 degrees F., and the exhaust steam is used for the low potential heat factor, for temperatures below 212 degrees F.; the ratio of the high and the low potential heat is about 1 to 5 based on the thermo-units, and the total fuel efficiency is then about 50 per cent.; a fair rate of charge would be about 4 to 5 times as much for the high potential heat as for the low. The cost of electric cooking at 4 cts. per horse power hour is not greater than gas at $1 per thousand, provided the water heating is omitted. He believes that this double system brings electric heating to a practical and remunerative basis; he cites two illustrations of an approach to this system. He shows the effect on the load factor of a station and compares the prices charged by the New York Steam Company and the Edison Electric Illuminating Company, of New York, from which he finds that the former furnishes heat at 40 cts. for 1,110 thermo-units, while the latter, allowing 50 per cent. discount to large users, will sell 20,518 thermo-units for 40 cts., the ratio between the two being nearly 54 to 1; even allowing a charge of 5 times as much for the high potential heat as for the low, the ratio will still be 10 to 1, which indicates what might be accomplished could two plants be run conjointly for a multi-potential heat supply. He quotes from Lord Kelvin's well-known article of the year 1853, and suggests applications of it in the form of a uni-potential system which he thinks would largely increase the central station load factor. For electric heating to be economical a multi-potential system must be used. Regarding car heating he suggests that a small amount of sensible warmth is all that is necessary, and this can be produced by less than 100 watts per sq. ft. of surface and in a 20-ft. car 20 sq. ft. of radiating surface is sufficient for average conditions and 35 for extreme conditions. He suggests that electric roads should locate their stations near business blocks so as to utilize their exhaust steam for heating. Regarding the cost of electric cooking he refers to an experimental plant which has been operated for 15 months under ordinary conditions, the results of which show that the cost of electric cooking is practically equal to that with the gas and coal stove as usually run, when electricity cost 4 cts. per horse-power hour; under the best control this would be still more favorable. He sees no reason why hotels and public institutions operating their own plants so as to secure a multi-potential system should not employ electricity for cooking, very extensively and solely for the purpose of economy, for electricity in a well-designed isolated plant costs much less than 4 cts. per horse power hour; in domestic life the ratio required is found to be practically five parts of diffused heat and one part of high temperature heat.

Electric Motors at the Southwark Foundry.—A brief description of the electrical distribution of power at these shops is published in the "Amer. Eng. & R. R. Jour." for May.

Three-phase Plant at Pachuca.—A brief description of this plant, near the city of Mexico, is published in the "Eng. & Min. Jour.," May 4; the power is derived from a waterfall and aggregates 20,000 hp; the line potential is 10,000 volts.

Polyphase Plant.—An abstract of Mr. Boucherer's article, mentioned above, is published in the "Elec. Rev.," May 8.

TRACTION.

Mountain Railways in the Alps.—In a brief article by Mr. Boistel in "L'Ind. Elec.," April 25, he gives tabular data for five Swiss mountain roads for steep grades, three of which are operated electrically, one by steam (Pilatus) and another by a water counter-weight (Santerbrunnen), and compares the results. It appears that the cost of construction of the electric lines is about one-third of that of the others, the cost of operation from one to two-thirds, the weight of the trains from 40 to 63 per cent., and the fare 60 per cent.; the results therefore show in a striking manner the great superiority of electric traction for steep grade mountain roads.

Surface Contact System.—The recent paper of Mr. Vuilleumier on the system used at Lyons, mentioned in the Digest, Feb. 2 (for description see Oct. 13, 20 and 27), is abstracted in the "Jour. Inst. Elec. Eng." for April. The motive power is obtained from gas engines run with power gas; the results of some tests are given showing that with 10 cars at work the consumption of coal was from 2 to 3.5 pounds every kilowatt hour; the cost of the system is said to compare well with the overhead trolley system.

Electric Traction in a Mine.—The "Bul. Soc. Int. des Elec." for March contains a well-illustrated paper by Mr. Hillairet describing a provisional installation in a coal mine near St. Etienne, France, in which a locomotive is used; it has been in operation 15 months and the results are very satisfactory; the current is taken from a conductor about nine inches above the ground; the illustration of the locomotive was reproduced in the "Elec. Eng." (N. Y.), May 1.

Electric Traction on Canals.—The "Bul. Soc. Int. des Elec." for March contains a long paper by Mr. de Bovet giving an illustrated description of his system of canal boat traction in which the current is taken from a side overhead trolley wire and the tractive force obtained from an anchored chain passing over a side pulley on which the friction is produced by a magnetic pull. The illustrations of some of the apparatus were reprinted in the "Elec. Eng." (N. Y.), May 1.

Electric Ferry.—The "Elek. Zeit.," April 18, contains an illustrated article by Mr. Trumpy, describing the electric ferry at Bergan, a full abstract of which with the illustrations, was published in The Electrical World last week, page 553.

Accumulator Traction.—A summary of the data for the experimental roads at Hagen and Vienna in which the alkaline accumulator is used, is given in "L'Ind. Elec.," April 25.

Traction Motors.—In Mr. Dawson's long serial on electric traction in Lond. "Engineering," April 26, he gives a well-illustrated description, including dimensions, of several of the prominent American and European motors.

Resistance of Traction.—A translation of Mr. Pellisier's recent article (see Digest, Dec. 6, 25, Feb. 23), is given in abstract in the "Jour. Inst. Elec. Eng." for April.

Geneva.—A translation of the description of this road, referred to in the Digest, April 6, is given in abstract in the "Jour. Inst. Elec. Eng." for April.

Railway Competition.—The "Eng. Mag." for May quotes from a recent article in the "R. R. Gaz.," March 29, and comments on it. In the quotation it is stated that the true cost of performing the service receives very little attention from the "aggressive competitors" (referring to the trolley roads); electric roads with a new track and equipment can get along for a while with very little expenditure for repairs, and managers in many cases base their calculations on a false assumption that the first low operative expenses can be permanently maintained, "they know it is false but that makes no difference"; the favorable attitude of the public may not last and taxes may be imposed where now everything is free. Quoting from the same journal for April 5, it is thought certain that the trolley lines will before long begin to do a parcel express business and can carry this on with great efficiency; it is quite probable that they may eventually carry heavy freight to some extent. The question is asked how steam roads are going to defend themselves, and it is suggested that they will either use electricity themselves and build cheap branches or buy up the electrical lines outright and operate them as an integral part of their system; the convenience of the public must finally decide the question of competition "and it is idle for any one to claim that electric lines shall be confined to the limit of the old horse car roads in our large cities;" the inevitable mutual adjustment of the competition is a matter which individuals, legislatures and courts are alike powerless to prevent.

Direct-Connected Machines.—The "St. Ry. Jour." for May contains a communication from Mr. Wright (of the Siemens & Halske Co.) giving his views regarding the direct-connected machines. If the choice is between several belt connected generators and a large direct-connected generator the latter will prove the cheapest in first cost, in operation and especially in maintenance; the saving in the cost of operation will be from 20 to 40 per cent.; he gives the loss of energy due to the use of belts under favorable conditions as assumed by leading companies in the United States, which are as follows: horizontal belts 6 per cent., vertical 10 per cent., countershaft with horizontal belt 12 per cent., countershaft with vertical belt 16 per cent., slow-speed engine with main and countershaft and belts 25 per cent. He quotes from an article by Mr. Crompton published about a year ago. In nearly every case he (Wright) believes that the ultimate economy will warrant the adoption of direct-connected machinery; with a station of sufficient capacity he recommends 2,000 hp as a unit. He quotes Mr. Kapp as showing that more than four times the electrical output can be obtained at a little more than twice the cost in a large as distinguished from a small dynamo.

Emergency Brake.—Mr. Walker in the "St. Ry. Gaz.," May 4, states that the Bonta brake (see Digest, May 4), is exactly the same as the one which he has been using on steep grades for over three years with perfect satisfaction and he now has a great many in operation; a single movement of the switch handle stops the car in about a single car length when it is at full speed; the cost of the attachment on the old Sprague switches is less than one dollar.

Conduit Systems.—The Olbricht system is briefly described and illustrated in the "Elec. Rev.," May 8; it is quite simple, the two conductors being secured directly beneath the two flanges forming a slot; (how the pressure of heavy wheels on the slot is taken up is not shown).

A description of the Dion system, taken from a daily newspaper, is given in the "Elec. Eng.," May 8; the system is being tried in Brockton, Mass.

Heilmann Locomotive.—A brief illustrated description of one of the new locomotives, which are approaching completion, is given in the "St. Ry. Gaz.," May 4.

Electric Carriage.—The "first electric carriage in Boston" is illustrated in "Elec. Rev.," May 8.

Rapid Transit in Philadelphia.—A recent discussion on the subject at the Engineers' Club of Philadelphia is published in their "Proceedings" for April.

Power for Electric Railways.—The translation of Mr. Pellissier's article, abstracted and referred to in the Digest, Dec. 8, 22, and Feb. 23, is published in "Elec. Age," May 4.

Motor Repairs.—The "St. Ry. Jour." for May contains an article by Mr. Shepard on repairing the Westinghouse motor.

Legal Aspect of Electrolysis.—Mr. Townsend's article, which was abstracted in the Digest, April 13, is reprinted in the "West. El.," May 11.

Detroit & Mt. Clemens High Speed Railway.—A description of this line, which is under construction, is published with a number of illustrations in the "St. Ry. Gaz.," May 4; the "St. Ry. Jour." for May contains a brief description of it. The line is about 15 miles in length and the cars will be run at a speed of 35 miles an hour; the road is practically without grades or curves; each car will be equipped with two motors having an aggregate capacity of 100 hp and is intended to draw a trailer; the line is designed to carry freight as well as passengers.

Electric Railways in Connecticut.—A short article in the "St. Ry. Jour." for May gives a map of the State of Connecticut with the lines of the New York, New Haven & Hartford R. R. Company together with the electric railways in operation and in course of construction. A table is given showing the falling off in the steam railway traffic on different roads due to the parallel electric lines.

Philadelphia.—A brief summary of the electric roads in Philadelphia is given in the presidential address of Mr. Trautwine in the "Proc. Eng. Club, Phila.," for April; at the end of 1894 the total mileage of the electrical roads was 250.

Hoboken.—A well-illustrated description of the North Hudson County Railway is published in the "St. Ry. Gaz.," May 4.

Steinway.—A well-illustrated description of the power house of this railway is published in the "St. Ry. Jour." for May.

Columbus.—A new power house of the Columbus Central Railway Company is described and illustrated in "Elec. Ind." for May.

Hartford.—A long well-illustrated description of the street railway system of Hartford is given in the "St. Ry. Jour." for May.

Lock Haven.—Some details of this road are described and illustrated in the "Elec. Eng.," May 8.

Dayton.—A brief illustrated description of this road is given in "Elec. Ind." for May..

Chicago.—A brief description of the Metropolitan West Side Elevated Road is published in the "St. Ry. Jour." for May.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Regulating Installations Driven by Turbines.—The "Elek. Zeit.," April 25, contains a long article by Mr. Egger in which he calls attention to the difficulties in regulating the speed in electrical installations driven by turbines and describes an apparatus devised by himself which is in use in a number of installations with great success, in some of which the ordinary methods failed completely. The principle of the apparatus is to automatically insert a resistance in the circuit of the dynamo corresponding to a load equal to the difference between the full load and that which is being utilized, thereby always keeping the load on the dynamos and turbines exactly the same; the resistance consists of an electrolyte made of water and soda, and containing one fixed electrode and another movable one the latter being inserted to a greater or less depth by an automatic apparatus; the electrodes consist of a row of carbon rods; the movable electrode is connected to the armature of a machine like a dynamo, whose armature, however, has only one large coil and no commutator (being therefore the equivalent of a mere magnet); this machine is series wound and is connected in the main circuit, the current in which is to be kept constant; the current through this regulator tends to turn the armature so as to lift the electrode out of the solution and a counterweight tends to move it in an opposite direction; the current through the resistance shunts the motors in the circuit; for different positions the torque for a constant current is said to be nearly constant and a position of equilibrium between this torque and that of the counterweight will be reached for loads in the external circuit. The results obtained are said to have been surprisingly good; the greatest difference in speed which could be noticed was only 2 per cent.; he suggests using a similar principle for other automatic regulators.

Installation Statistics for Japan.—The "Elec. Friend" (Japan) for March gives full statistics for isolated lighting plants in Japan up to August, 1893; total 54, number of incandescent lamps 17,145 nearly half of which are used in cotton factories, number of arc lights 123; the first isolated plant was installed in Japan in April, 1883, in the Yokosuka navy yard.

Statistics for Germany.—The Lond. "Elec.," April 26, abstracts briefly the table of statistics referred to in the Digest, April 27.

Navel Lighting System.—There is a proposal on foot to light various towns and villages near the Seine from Paris to Havre consisting in providing the cities with accumulator plants which are charged from a large floating central station which is moved up and down the river, charging batteries in turn.

Tokio.—According to the "Elec. Friend" (Japan) for March the chimney for the Electric Light Co. of that city is made of iron lined with brick; it has no stays; the height is 200 feet, the diameter at the top 9 feet, and at the base 18 feet; it appears to withstand the frequent earthquakes in that country.

Leicester.—A description with good illustrations of this alternating current station is published in the Lond. "Elec. Rev." and "Elec. Eng.," April 26, the latter containing a plan.

Belfast.—A description of this accumulator station with some good illustrations, is published in the Lond. "Elec. Rev.," April 26.

Louisville Auditorium Plant.—An illustrated description is published in the "West. El.," May 11.

Manchester.—A brief description of this English municipal plant, giving costs, is published in the "Elec. Rev.," May 8.

WIRES, WIRING AND CONDUITS.

Underground Mains in Berlin.—A translation of the portion of Dr. Kallmann's paper referring to the precaution taken to insure safety, is published in the Lond. "Elec.," April 26; the paper was referred to in the Digest, April 27. A somewhat lengthy discussion of the paper is reprinted apparently in full in the "Elek. Zeit.," April 18.

Bending Tests for Copper Wire.—The "Bul. Soc. Belge," Oct.-Dec., contains a short article by Mr. Colard in which he gives simple formulas for calculating the number of bends which a wire of a given diameter will stand, through a circle of given radius; tables of data are given showing how the figures agree with those obtained from experiments.

Earthing the Neutral Conductor.—The Lond. "Elec.," April 26, reprints in part a translation of the report referred to in the Digest, April 13, which is strongly is favor of earthing; the report is discussed editorially.

Distribution Tower.—That used in the Salzungen installation referred to in the Digest, May 4, is illustrated in the "West. El.," May 11.

ELECTRO-PHYSICS AND MAGNETISM.

Alternating and Interrupted Electric Currents.—A reprint of a Royal Institution lecture by Prof. Forbes is begun in the Lond. "Elec. Eng.," April 26; the whole lecture is briefly abstracted in the Lond. "Elec. Rev.," April 26. He describes mechanical analogies for the various cases of the propagation of electricity with special reference to submarine telegraphy. Among others he describes an experiment with an endless chain hung vertically over a motor pulley and driven at a high speed, which then acts like a rigid body, going through a series of motions if displaced (but in the present portion he does not seem to draw any analogies from it). Electrical momentum corresponds to self-induction and capacity involves a certain pliability or flexibility of the chain, representing the conductor; the torque or twist in a shaft is analogous to a current in a conductor; capacity may be taken as a yielding in the direction of motion; a further analogy with a cable is illustrated but the description in the abstract is not sufficiently clear, (it will be referred to again when the paper is published in full.)

Effect of Electric Railways on Physical Laboratories.—According to an editorial in the "Elek. Zeit.," April 25, the Electrical Society of Germany and the Imperial Technical Institute are about to investigate and report on this subject, compiling the literature, including any communications which may be sent them; the chief questions are how great the effect on the magnetic field is and for what measurements and researches the use of instruments which cannot be made to be independent of the earth's field, are absolutely necessary.

Electrostatic Capacities.—The Lond. "Elec. Rev.," April 26, calls attention to the recent (American) paper by Prof. Nipher calling attention to an error in the statement that the lines of force or induction around an electrified body distribute themselves as if the space offered resistance to their passage; this is not the case, which is shown by reference to a hollow spherical conductor with an opening into its interior and which would be absolutely devoid of charge on its inner surface but if immersed in a conducting fluid quite an appreciable amount of current would flow from the inside, neither could the discharging effect of points be properly accounted for on this resistance basis; the analogy fails wherever the shape of the body causes a want of uniformity in the surface density. The statement that the difference of the electric potentials produces electrostatic induction is claimed to be very misleading as it gives the impression that the electrification of the body is the primary effect and the propagation of lines of induction the result.

Electrostatic Rotation of Rarefied Gases.—A brief abstract of an article by Mr. Arno is given in the "Jour. Inst. Elec. Eng." for April.

Propagation of Magnetization in Iron.—The paper of Dr. Hopkinson and Mr. Wilson, which was abstracted in the Digest, March 16, 23 and 30, is published in full with the discussion and illustrations in the "Jour. Inst. Elec. Eng." for April. Several of the illustrations of this paper are published, with a brief description, in the Lond. "Elec.," April 26.

Form of a Flexible Conductor in a Magnetic Field.—"L'Eclairage Elec.," April 13, contains the first part of a mathematical article on this subject by Mr. Colard.

Foucault Currents.—A mathematical article by Mr. Janet is published in "L'Eclairage Elec.," April 13.

Mechanical Equivalent of Light.—The Lond. "Elec. Rev.," April 26, calls attention to an error in the cut referred to in the original of the article which was abstracted in the Digest last week.

Compass Deflections.—The "Eng. Mag." for May quotes from a letter by Capt. Malet in the "Nautical Mag.," in which he refers to the effects of magnetic storms, as often indicated by auroras, upon eccentric variations of the compass needle and he suggests that when an aurora is visible the navigator, essentially when near land, will do well to watch the compass closely for any eccentric movement.

ELECTRO-CHEMISTRY AND BATTERIES.

Accumulators.—The Lond. "Elec. Rev.," April 26, publishes a short report by Mr. Hall concerning comparative tests between the International Storage Battery Co.'s cell and the E. P. S. cell; the results

are merely relative, no actual capacities, rates, or weights being given. At rates equal to from six to eight times the maximum rate for the E. P. S. cell the capacity of the former was from 3.4 to 2.77 times as great. The claims made for it are high rate of discharge, high capacity per weight and greater mechanical strength. To give 5 hp for 19 hours requires 2,915 pounds of battery. The report is very vague and unsatisfactory and is severely criticised in the leading editorial in that journal where it is stated to be absolutely meaningless on account of the absence of statements of actual discharges.

Accumulators.—An illustrated description of a number of different forms is published in "L'Eclairage Elec.," April 13.

Pulverizer.—A well-illustrated description of an apparatus intended chiefly for pulverizing lead for accumulators, is given in "L'Eclairage Elec.," April 13; a stream of hot air is blown through a nozzle through which molten lead flows.

Ferricyanide of Potassium as an Oxidant.—The Lond. "Elec. Rev.," April 26, states that ferricyanide of potassium has a great tendency to become ferrocyanide exercising an oxidizing action in doing so, and adds that this reaction can readily be reversed by electrolysis.

Production of Organic Compounds.—In a short article by Mr. Hess in "L'Eclairage Elec.," April 13, he discusses the possible application of electrical energy for the protection of organic compounds; it deals with the compound carbide of calcium and its application for producing acetylene and organic compounds.

Nickel Plating.—According to "L'Elec.," April 27, the bluish or greenish oxide which forms on nickel-plated objects can easily be removed by a solution of 50 parts of rectified alcohol and one part of sulphuric acid, after which the object is washed in alcohol.

Quantitative Analysis.—The Lond. "Elec. Rev.," April 26, calls attention to a paper by Mr. Classen in the "Ber. Deut. Chem. Gesellschaft," 27, p. 2,060, and to another in the "Zeit. f. Ang. Chemie," 1894, p. 388, by Mr. Rudorff.

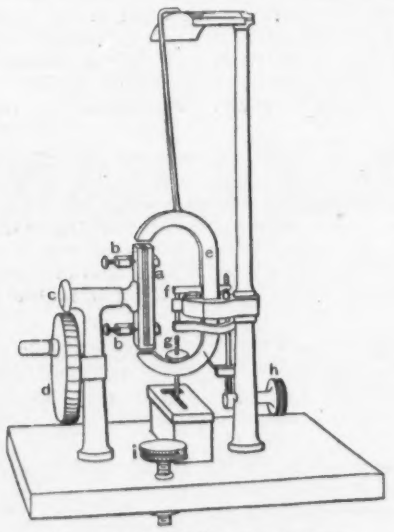
Recent Advances in Electro-chemistry.—The "Jour. Frank. Inst." for May reprints in full a recent lecture by Dr. Richards giving a very good summary of the recent progress. With but very few exceptions the subject matter in this lecture has appeared in the Digest, although in many cases in less detail.

Electricity Direct from Coal.—Mr. Bucherer's recent paper, a full abstract of which was published in THE ELECTRICAL WORLD, April 6, is published in full in the "Jour. Frank. Inst." for May.

Cyanide Process for Gold Extraction.—The "Eng. & Min. Jour.," May 4, contains a long communication by Mr. Audreoli (of London) with special reference to the recent litigation in England.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Magnetic Tester for Measuring Hysteresis in Sheet Iron.—An Institution paper by Prof. Ewing is reprinted with illustrations and curves in the Lond. "Elec." and the "Elec. Eng.," April 26; he describes in detail a very interesting instrument devised by himself for measuring the hysteresis loss in samples of iron by a simple and rapid process suitable not only for the laboratory but also primarily for the workshop. He calls attention to the need of some simple apparatus by which the hysteretic loss can be determined readily, stating that extraordinarily wide



EWING'S HYSTERESIS METER.

differences exist in different samples of iron, the range being nearly three to one in good and bad samples, and even in the same batch of plates such differences exist between one plate and another as to make the testing of a single sample a poor guide; he has noticed a difference of 15 per cent. in samples taken from the four corners of a plate not two feet square. He considers the ballistic method unimpeachable on the score of accuracy, but it is not simple and expeditious. The permeability in transformer iron is quite a secondary matter, hysteresis being of primary importance and high permeability is not necessary or invariably associated with small hysteresis. The basis of the present instrument is the mechanical measurement of the work done in causing reversals of magnetism to take place in the iron under examination; referring to the adjoining figure the iron to be tested is cut in the form of strips three inches long by five-eighths of an inch wide, six or seven pieces being generally sufficient; this bundle of pieces is secured to the carrier which is made to rotate by hand by the friction pulley and the driving wheel; the rotation takes place between the poles of the permanent magnet *e*; the work done by hysteresis tends to revolve the magnet which is supported on a knife-edge at *f* in line with the axis of the carrier, and the angle through which it is deflected serves to measure the work done, this angle being read off upon the scale at the top of the instrument. Since a definite amount of work is done for each reversal whatever the frequency as long as it is not so high as to generate work by inducing currents, the deflection of the field magnet is independent of the speed at which the carrier revolves and no special care need therefore be taken to turn the handle at a uniform rate; the sensitiveness is adjusted by means of the weight *g*; the deflection is very nearly proportional to the hysteresis of the iron even with samples differing very widely in quality; to secure this a considerable air space is left between the magnet poles and the ends of the sample so that the variations in permeability liable to be met with are almost without influence on the total induction; the induction was found to be practically the same in the best and worst specimens; the magnet was so proportioned that the induction was about 4,000; within reasonable limits any value of this intensity may be adopted as the relative amounts of hysteresis in different samples change very little with the induction. Care has to be taken to make the strips always the same length so as not to change the air gaps, but the width requires no particular care; he finds that no nice adjustment of the weight is required and explains the tests made to determine this; he tested different numbers of the strips varying from 11 to 1, giving the results in tables and curves, the latter showing that the scale readings pass through a very flat minimum for about seven pieces, there being no material difference between six, seven and eight, hence if the weight chosen is made equal to seven pieces it will suffice; the nearest whole number of strips will do; in testing armature plates a smaller number of pieces approximating the same weight are used. He describes very careful tests which were made to calibrate the instrument in order to determine the degree of accuracy of these readings as compared with those obtained by the ballistic method, testing the same iron by both methods; the results were found to accord well with one another, the scale reading of the magnetic tester being furthermore nearly proportional to the hysteretic loss; a straight line drawn from the origin to the observed points lies sufficiently near to all of them to allow the assumption of proportionality to be made as far as workshop testing is concerned; more exactly, the straight line passes a little to the right of the origin. It is intended to furnish each instrument with two standard samples of iron, together with a table giving their hysteretic loss as found by the ballistic measurement; in testing other samples the operator first notes the deflection given by the standard pieces, which serves as a calibration. The standard sample induction is taken as 4,000; to find the hysteresis for any other induction he gives a table of factors which he has deduced as a general mean from ballistic tests of many samples. The instrument might have been constructed by making the field revolve or making the axis vertical with a controlling spring, but he believes the form adopted is the best. In the discussion the instrument was greatly praised by Profs. Fleming, Foster, Forbes, Ferranti and Esson. Prof. Ewing stated that although intended primarily for the shop the instrument was also adapted for the laboratory, he used it himself in preference to the ballistic method for all except a comparatively small number of purposes.

In discussing the paper the Lond. "Elec." referred to a source of error the elimination of which was not made quite clear in the paper, namely, the fanning which the revolving sample may exert on the delicately suspended magnet and which would not be eliminated by turning the sample in the reverse direction; in this connection it refers to a new apparatus by M. Deprez, of Paris, which appears to be similar except that round discs are used, the use of which might eliminate this error due to fanning.

Platinum Thermometer.—In Mr. Crompton's paper on electric cooking and heating, abstracted above, he describes his platinum thermometer which was used in the measurements. It consists of a spiral of a thin strip of platinum 0.002 in. thick by 0.05 in. wide, of sufficient length to have about five ohms resistance at 0 degrees C.; it is wound in the form of a double spiral on a strip of mica about one-half inch wide by four inches long which is enclosed and held between two similar sheets fastened at their edges, the total thickness of the whole being not more than that of a sheet of paper, and it can therefore be brought to within 0.01 of an inch from the surface whose temperature is to be measured. It is connected in series with a standard resistance of manganin and a small current from an accumulator passes through them; they are so adjusted that the voltage measured by a potentiometer is exactly the same on both when the platinum is surrounded by melting ice; the platinum is then exposed to boiling water and again compared on the potentiometer scale, the distance between the two points being divided into 100 parts each, therefore corresponding to one degree C.

Quadrant Electrometer as a Differential Instrument.—The "Elec. Zeit.," April 25, contains an article by Mr. Eisler in which he states that every quadrant electrometer can be connected like a differential galvanometer and can be used for a zero method for measuring resistances with both direct and alternating currents; for the latter it offers special advantages as it is the only possible zero method for measuring apparent

resistances. He gives briefly the theory of the instrument for continuous and for alternating currents; the two resistances to be compared are connected in series, the needle of the electrometer is connected to their junction and each pair of diametrically opposite quadrants are connected to their other ends; the electrometer therefore compares the voltages at the terminals of these two resistances. It has been said even in authoritative books that the Wheatstone bridge can be used for measuring apparent resistances but this he says is impossible and proves it mathematically. As an illustration of the application of his differential method for measuring the apparent resistance, he cites the case of a 1-kw transformer which gave an apparent resistance of 4,010 ohms to an accuracy of 0.1 per cent., the current used being about 0.01 amperes; as the ohmic resistance was very small, the self-inductance is 15.3 henrys; he adds that the results will be correct even if the current is not a truly sinusoidal one.

Absolute Electrometer.—A more complete description of the instrument mentioned in the Digest last week is published in "L'Elec.," April 27, and "L'Ind. Elec ," April 25.

Hot Wire Instruments.—An illustrated description of the Hartmann & Braun ampere and volt meters, in which two wires at right angles are used, is published in "L'Elec.," April 27.

Nalder Ampere Meter.—A well-illustrated description of this instrument is published in "L'Eclairage Elec.," April 13; in principle it resembles the Weston instrument; a registering maximum and minimum instrument is also illustrated.

Sensitive Galvanometer.—A more complete description of the Weiss instrument (see Digest last week) is published in "L'Elec.," April 27, and "L'Ind. Elec.," April 25.

Apparatus for Measuring the Specific Inductive Power of Solids and Liquids.—An Academy paper by Mr. Pellat describing a new apparatus is reprinted in "L'Ind. Elec.," April 25.

Measurements of Self-Inductances.—The "Bul. Soc. Belge," Oct.-Dec., contains a paper by Messrs. Roosen, Colard and Close in which they describe briefly several methods of measurement and give the results of a large number of measurements of telegraphic and telephonic instruments; some of these results were given in THE ELECTRICAL WORLD, April 27, page 507. The method used for measuring discharge deflections is of interest; the scale is provided with a movable pointer with a red line on it, this being placed as near as possible to where the deflection is to be read off, the point being determined by trial; for the final reading it then suffices to read the difference between the deflection reading and the position of the red line, a distance which is always very short; this method is used when the discharge deflections are very rapid.

Researches with Induction in Cables.—Dr. Breisig's long serial is concluded in the "Elek. Zeit.," April 18; he discusses at some length the theory of the circulation of alternating currents in two mutually inductive lines.

Determination of the Spherical Intensity of Lights.—In a continuation of Prof. Blondel's article in "L'Eclairage Elec.," April 13, he gives a summary of the well-known formulas for continuous and alternating current lamps and incandescent lamps; the article is of interest but does not admit of being abstracted.

Measurement of Resistances.—A brief abstract of the article of Mr. Colson on the measurement of resistance by means of alternating currents and the telephone (see Digest, Feb. 16), is published in the "Jour. Inst. Elec. Eng." for April.

New Form of Carey-Foster Commutator.—A new form devised by Prof. Stine for the Armour Institute, is described and illustrated in the "Elec. Eng.," May 8; the leading features are directness of all connections, absolute freedom from liability of short circuits and that all connections may readily be seen.

Simple Electric Chronograph.—The "Elec. Eng.," May 8, abstracts from the "Amer. Jour. of Sc." (no date given) a brief description of a device of Mr. Barus.

Magnetic Tester for Measuring Hysteresis in Sheet Iron.—Prof. Ewing's article abstracted above, is reprinted in full with the illustrations in "El'ty," May 8.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephone Induction Coils.—The new and improved form adopted by the German government and devised by Mr. Muench, is described and illustrated in the "Elek. Zeit.," April 25. The two objects to be accomplished were to diminish as much as possible the magnetic inertia of the iron and the electrostatic capacity between the two coils. The core is a small bundle of iron wires which have been shellaced to keep them from coming in contact with each other; the length is 5⅛ in. and the diameter about 1⅛ in.; after covering it with paper, the primary and secondary windings are wound on it, each consisting of about 4,000 windings and 10 layers of a 0.2 mm wire and these are then surrounded by a layer of iron wires about a quarter of an inch thick; the resistance of the primary is about 200 ohms and of the secondary 250; the apparent resistances and the self-inductances under different conditions are given; the electrostatic capacity between the two windings is extremely small, being 0.00185 microfarads; the efficiency is estimated to be about 97 to 98 per cent.

Effect of Traction Currents on Telephone Circuits.—The "Bul. Soc. Belge," Oct.-Dec., contains a long paper by Mr. Boulvin in which he describes in detail experiments made in Brussels with telephone circuits in the neighborhood of traction circuits; he discusses the electrolytic action of a return circuit, the dangers to persons and telephone installations caused by contact with the traction conductors, and disturbances produced in telephonic communications.

Disturbances in Telephone Wires from Neighboring Conductors.—Mr. Pierard's article (see Digest, Feb 9 and 23), is translated in abstract in the "Jour. Inst. Elec. Eng." for April.

Telephony in Japan.—The "Elec. Friend" (Japan) for March describes the telephone system on the Kobu railway; No. 11 B. W. G. galvanized iron wire is used; the system comprises five circuits embracing from two to eight stations each and covering a total distance of 83 miles.

Telephone Set.—The Morlé and Porché form intended for the table, is described with illustrations, including a diagram of the connections, in the "Elek. Zeit.," April 25.

Microphone.—The description of the new Mercadier and Anizan microphone, an abstract of which appeared in the Digest, Feb. 2, is translated in abstract, briefly, in the "Jour. Inst. Elec. Eng." for April.

Telegraphy.—In an editorial in the "Elek. Zeit.," April 18, the systems used in different countries are discussed briefly and it is pointed out that the ordinary system using the sounder is the most reliable, both for sending and for receiving; this was found to be the case in England; in regard to simplicity it far surpasses all others. The Wheatstone automatic is highly spoken of and, it is claimed, should be introduced on long direct lines as soon as there is sufficient traffic to require the laying of a second line.

Submarine Cables.—According to the "Elec. Friend" (Japan) for March a single core cable of 20 knots was laid by the Japanese engineers on the 8th of March between Japan and Corea to replace the faulty one formerly used; three knots at each end are shore-end cables.

Submarine Cables.—The Lond. "Elec. Rev.," April 26, calls attention to the great advantages of nickle-steel wire, which is practically non-corrosive and as strong as the best steel; it suggests that submarine cables be covered with this in preference to galvanized iron or steel wire.

Open Circuit Telephone System.—Amsterdam's system is briefly described and illustrated in the "Elec. Eng.," May 8; the currents are transferred by induction to the main line which has free ends; the advantage claimed is that the circuit is then incapable of transmitting or transferring telegraph signals; (according to the illustration the two wires between which the induction takes place, are run parallel near to the line; what the advantages of this are over an induction coil, like in the phonopore, is not explained).

History of the Telephone.—"Cassier's Mag." for May contains a short article by Mr. Jones, including some diagrammatical illustrations, of each of the prominent systems.

The Telephone and Its Operation.—"Cassier's Mag." for May contains a profusely illustrated article by Mr. Brooks.

Telegraphy as It Used to Be.—"Cassier's Mag." for May contains a well-illustrated article by Mr. Lodian describing some systems of signaling in use in olden times in France.

Time Service System.—A brief illustrated description of the system used in Milwaukee is contained in the "Teleg. Age," May 1.

MISCELLANEOUS.

Application of a Heated Wire.—In an article by Mr. Irish on "Non-magnetic Electric Devices," in the "Elec. Eng.," May 8, he describes and illustrates diagrammatically a large number of devices in which the expansion of a wire heated by a current passing through it, is used to replace the pull of an electromagnet. From a large number of experiments covering a period of several years, he is lead to the conviction "that electromagnets will in the near future be found only as relics of the past in museums." The advantages offered by the heated wire are said to be that it has comparatively no resistance or counter E. M. F. as compared with an electromagnet and that it will give the same results with fewer parts, greater simplicity and higher economy; among the large number of devices are a recording telephone and a "non-magnetic electric motor." In conclusion he states that a weight of ten pounds was repeatedly lifted with the heat derived from a match (but how often or how high is not stated). He remarks that it may be argued that the expansion of the wire is too sluggish for telegraph instruments, etc., and adds that this will be the case if the strip is too large or the current too weak, but the same adjustment applies equally to the electromagnets; (this is the only reference made to the objections which would naturally suggest themselves and which have doubtless been the reason why this well-known principle has been used so little; no references are made to high voltage or shunt magnets nor to the economy, or to the loss of the advantages due to the polarity of electromagnets).

Death from 280 Volts.—The "Elec. Eng.," May 8, contains several suggested explanations of the phenomena referred to in the Digest, May 4. Mr. Lamb says that even 110 volts will kill if applied to a bleeding sore and allowed to remain on a few seconds; the fact that it does not paralyze the nerves and that therefore contact can almost always be broken at once, is the reason why so few deaths have been occasioned by it; he believes that 280 volts in contact with a bleeding sore will kill almost instantly; he quotes Mr. Tesla as saying that 10 volts applied to a bleeding sore on the hand would put a man to sleep; (nothing is said

of the second contact, which, it seems, would have to be almost equally good). Mr. Hench believes that the circuit supplying the power was probably broken at the moment that the victim was in contact with the machine and that he therefore received the induction current. Mr. Tyler believes that the cause of the death was from the shock, citing a number of cases in which the effect of an unexpected shock was much greater than that of one which was expected.

Carbide of Calcium and Acetylene.—The "Jour. Frank. Inst." for May reprints in full a recent lecture by Messrs. Willson and Suckert giving a good summary of the subject, illustrated with a number of diagrams. They state that extended experiments have shown that one electrical horse-power readily produces 20 pounds of calcium carbide per 24 hours and present indications justify the assumption that with automatic feeding and proper insulation of the heat and the utilization of the waste heat, this can be increased to 30 pounds; they believe that the compound can eventually be produced at a cost of less than $5 per ton; some detailed estimates for a large plant are given; it is stated that arrangements are now being made to apply 1,000 electrical horse-power of the Niagara Falls plant for the manufacture of this material and this is shortly to be increased to 5,000 hp "and eventually we will without doubt see the entire available power the company now possesses converted into electrical energy for the manufacture of this product."

Electric Weed Killer.—The "Amer. Eng. & R. R. Jour" for May contains a brief description by Mr. Armstrong of a method of killing weeds on railroad lines, with which experiments have been carried on for some time. It consists of a 2,000-volt alternator mounted on a car the current of which is transformed up to from 6,000 to 24,000 volts depending on the kind and quality of the vegetation to be destroyed; the current is conducted through a series of fine wires to the tops of the weeds or grass, the other pole being connected to the ground through the rails; it traverses the entire length of the plant including the roots, rupturing the cellular tissues and thereby totally destroying it, especially the root which appears to suffer most; he states that the device is entirely practical; the discovery of the method is due to Capt. Sharp; it is said to reduce the cost of maintenance of right of way about $40 to $80 per year per mile; he believes that it will prove of great benefit for the extermination of the Russian thistle.

Cleaning Ships' Bottoms.—According to the "Eng. Mag." for April, it is reported that a method has been discovered by which the bottoms of sea going vessels may be kept clean with the use of an electrical apparatus and without docking; the process is not explained.

Biographical.—A brief sketch with a portrait of Alexander Graham Bell is published in "Cassier's Mag." for May.

New Books.

A Standard Dictionary of the English Language. Upon Original Plans. Prepared by more than 200 specialists and other scholars, under the supervision of Isaac K. Funk, D.D., Editor-in-chief. Vol. II. New York: Funk & Wagnalls Co., 1895. 2,338 pages, 5,000 illustrations. Price, complete, $12.

The second volume of this work fulfills in every respect the promise of the first volume. There is the same excellent typography and binding, and the plan on which it was started has been most completely carried out.

This plan covers much more than has heretofore been considered to be lexicography. The work is, therefore, to a large extent an encyclopedia, and, furthermore, in some cases there have been original investigations made expressly for the purpose of settling doubtful points, so that accurate definitions might be given.

This is notably the case with the different shades of color. With the exception of a few important colors, such as red, blue, green, there has heretofore been great uncertainty as to what tint is meant when a particular name is mentioned. The editors have therefore endeavored to establish a standard nomenclature of colors to represent as nearly as possible the average usage of the present day among dyers and others who have occasion to classify colors; and having once established a standard color scale, each color is expressed in terms of certain other colors which are assumed as primaries, by means of experiments with Maxwell's color discs.

There can be but one opinion as to the value of the information derived from this investigation, although there has been some difference of opinion as to the propriety of publishing this class of information in a dictionary. Strictly speaking, this is not, of course, lexicography, and the adverse criticisms of the work so far are mostly based on the charge of too great inclusiveness, but the average purchaser will not be likely to complain because the work contains more than its title indicates.

Another peculiarity of the plan of this work, regarding the propriety of which there has been some difference of opinion, is the method of deciding the correct meaning of a word. The criterion of the Standard is in every case present usage, rather than etymology or scholastic opinion. This method, whether it be regarded as the best or not, is, at least, faithfully carried out, like all other parts of the original plan.

The work contains not only all ordinary words, but a most exhaustive vocabulary of all technical terms, including all the new words in the science of electricity, even "reactance," which is the latest of all. There is a very complete list of synonyms given with all common words, and also antonyms where there are any.

Some idea of the completeness of the scientific vocabulary may be formed from the statement that the space of two columns is devoted to magnetism and allied words. This list begins with "magne-crystallic," which is a rare word even among electricians.

Further on the word "magnetine" occurs (also, alternatively, without the final *e*,) which is defined thus: 1. A hypothetical imponderable substance assumed to be the medium of magnetic phenomena. 2. A compound of cement and some magnetized material, used in magnetic belts, etc. At the end of the magnetic list we find "magnetod," the same as magnetine, and a reference to "od." Looking up *od* we find, as might be expected, that it relates to Baron von Reichenbach's odic force.

This, then, is all that there is of the first definition of magnetine, and as to the second definition, it appears to be only a trade name, and no more entitled to a place in a dictionary than micanite or cuticura, if, indeed, it is not the name of some electrotherapeutic humbug.

Ohmage, as the analogue of voltage, is given. Ohmic is defined, "Of or pertaining to an ohm; measured or capable of being measured in ohms." This is not quite satisfactory, as the practically exclusive use of the word ohmic has heretofore been in the combination "ohmic resistance." In this case ohmic means of or pertaining to Dr. G. S. Ohm's original conception of resistance, that is, true resistance as distinguished from spurious resistance, and has no reference to the unit called ohm. Ohmic resistance is still ohmic, though it be measured in Siemen's units, electrostatic units, or any arbitrary units. On the other hand, the different kinds of spurious resistance, such as that due to self-induction or to electrolytic polarization, may be and usually are measured in ohms. Again, reactance, which is not even a spurious resistance in the ordinary sense, is measured in ohms.

The scientific alphabet of the American Philological Association has been adopted as a key to pronunciation. This is a good plan, as the methods of indicating pronunciation are nearly as numerous as the dictionaries in which they are used.

There is one respect in which the Standard is especially worthy of praise: namely, in the effort to form a consistent rule for writing compound words. A word which is formed by combining two separate words, may be written as a single word, may be written with a hyphen between the components, or as two separate words without any other sign of unity of meaning than juxtaposition. Heretofore it seems to have been purely a matter of chance how such words were written, but the Standard reduces them to a system of rules with as few exceptions as any other rules of English spelling or grammar.

Telegraphers of To-day. Compiled by John B. Taltavall, New York: Published by the compiler, 1895. 384 pages, quarto, 3 illustrations and 661 portraits. Price, $5.

This work has for its object to present biographical sketches of those who are prominent in telegraphic work to-day, or have been during the past 50 years, a portrait of each subject accompanying the sketch. The work is divided into four parts. Part I. is devoted to Western Union men and opens with engravings showing the Western Union Company's New York and Chicago offices. Next following is a magnificent full-page portrait of Gen. Thomas T. Eckert, with over a page of biographical matter.

Part II. embraces the prominent men in the Postal Telegraph service, the first in the list being Mr. A. B. Chandler, of whom there is a fine full-page portrait, corresponding with that of Gen. Eckert. An illustration of the splendid new building of the Postal Company is also given.

Part III. is devoted to "old timers" who have turned aside into other pursuits, but whose names are yet familiar to the telegraphers of the present day, among them being Ezra T. Gilliland, Thos. D. Lockwood, Dr. Wm. S. Morris, Ralph W. Pope, Jas. D. Reid, John Nelson Gamewell, Geo. F. Milliken, Thos. A. Edison, Jesse H. Bunnell, and D. H. Bates.

Part IV. includes men who are connected with the cable companies and press associations, opening with a full-page portrait of Mr. Geo. G. Ward. Some of the most familiar names in this section are those of Walter P. Phillips, P. V. DeGraw, R. W. Martin, Fred Catlin, "Billy" Kettles, and John B. Sabine.

It is unfortunate that many men who are now prominent in telegraphic circles and some who were well known a dozen years back, have been left out, but the scope of the work naturally precluded the possibility of absolute completeness.

The book is printed on heavy plate paper, in large type; the portraits are unusually well reproduced, and the binding is thoroughly tasteful and substantial. The work is of exceeding interest and value as a souvenir to those who are or have been connected with telegraphic work.

American Street Railway Decisions. Vol. II. By Chas. A. Richardson and A. J. Hook. Brooklyn: American Street Railway Association. 483 pages. Price, $5.00.

In the course of electrical progress the laws, while more intimately associated in electrical matters with patent rights, plays no mean part in street railway affairs. Franchise, right of way, speed of cars, injuries to passengers and others often involve a law suit, the decision of which forms a precedent which is of as much importance as the public statutes themselves in the adjudication of similar causes.

The cases in the courts are many and varied, and in order to have them of any value on a record, they must be classified and arranged for ready reference. The special classification that Messrs. Richardson and Hook have endeavored to give cases bearing on American street railways is a work of magnitude, and will prove indispensable to lawyers on street railway matters. The complete work purports to include all reported cases decided by the courts of the United States and Canada down to the present time, and it is estimated that six volumes will be necessary for this purpose.

The second volume has just appeared, and is doubtless a fair sample of the whole. The book appears to be a compilation from various digests, the cases being concisely discussed, with the evidence and whatever else is necessary to make the case intelligible given. Then follows the judge's decision, which really occupies the greater part of the space. The cases are chronologically arranged, and a copious index forms a special feature. A synopsis of each case is given therein, and one can gain a knowledge of the nature of the same without looking it up further. Thus the rapid selection of a case bearing on the matter in hand is greatly facilitated. Moreover, it is impossible to look up any one matter without having reference to all cases bearing at all on the subject. This, of course, involves much repetition of cases and their synopses, but this repetition is fully justified. The index comprises 76 pages and thoroughly reviews the 407 pages of text. To lawyers the work will be of value, and the cases are so clearly and concisely discussed without an excess of legal phraseology, that the layman street railway official can also refer to it with advantage.

Vol. II. includes the cases decided from 1860-64 inclusive, and relates largely to New York decisions. It is safe to say that the succeeding volumes will have a much more general interest to electrical men than is usual with such works. The series is of a standard nature, and its value cannot be disputed.

The well-known treatise on alternating currents, by Drs. Bedell and Crehore, has been translated into French by M. Jules Berthon and published by Georges Carré, 3, rue Racine, Paris, under the title "Etude Analytique et Graphique des Courants Alternatifs, A l'Usage des Ingenieurs et des Eléves des Ecoles."

The Arnold Alternating Current Motor.

A United States patent was issued on May 7 to Prof. E. Arnold, of Zurich, Switzerland, for a self starting, simple alternating current induction motor, the main feature of which, as will be seen below, is the arrangement and control of the field magnet circuits. By the method used the motor becomes self starting and objectionable losses of energy in starting up are obviated.

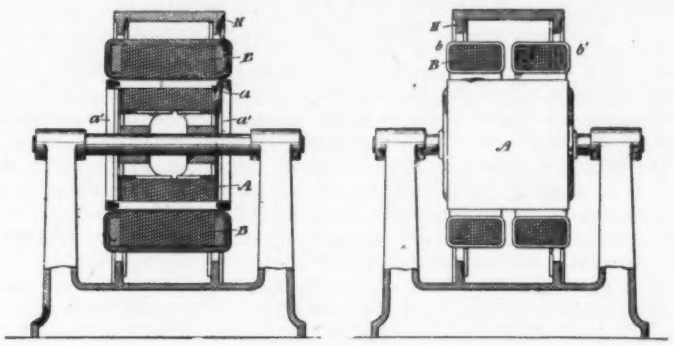
Reference is made in the specification to the manner in which the above difficulty has been attacked, some of the devices employed operating by unbalancing the magnetic field and others by commutating the induced currents in the armature. In the present instance an initial rotation of the magnetic field is effected, through which the armature is started, and when speed has been attained, the connections are changed in such a manner that the machine operates as a simple alternating current motor. At starting, current is supplied to the field magnets in such a manner as to produce one set of poles at certain points and a second series of poles at a different angular position to the first named. In this manner a successive shifting of the magnetic field takes place, which causes the armature to rotate and acquire speed. When sufficient speed has been attained, the connections of one or both of the two field circuits are changed until the poles produced by both of the field currents correspond, and the phases of the two currents are brought into synchronism, either by changing the inductance of one or by connecting the two sets of windings in series. When these changes have been effected the motor operates as a simple synchronous induction motor.

Where short-circuited armature windings are employed it is preferable to sub-divide them and close some of them through a resistance while starting; and then, as speed is attained, successively close the circuits of the other coils. In this manner less current is generated in the armature and heating and waste largely prevented. Where the field magnets are stationary and the armature revolves, it is not always convenient to make such armature connection, but where the field magnets rotate and the armature is stationary the opening and closing of the armature coils may be readily effected by a series of stationary switches.

Referring to the illustrations, Fig. 1 is a longitudinal cross section of one type of motor, showing the form of the field magnet and armature cores and some of the windings, with the electric connections and switches omitted. Fig. 2 is a similar view showing a modification of the form of field magnet cores. Fig. 3 is a diagrammatic illustration of the winding and connections of the field magnets.

Referring to Figs. 1 and 2, the armature is shown at *A*, the field core at *B*, and the housing or stationary frame of the machine at *H*. In Fig. 1 the field magnet core is of the ring type with inwardly projecting pole pieces. In Fig. 2 the field core is formed of two parallel rings carrying the respective field coils *b* and *b'*, the latter being commutated, to change the position of the poles produced by it in accordance with the invention. In Fig. 1, the armature windings are shown of the permanently closed circuit type, the parallel conductors or bars *a* terminating in the connecting rings *a'* at each end.

The field windings and circuit connections are diagrammatically set forth in Fig. 3. The field cores are indicated as above by *B*. For convenience of illustration two separate field cores are shown, as in Fig. 2, but the two sets of windings may of course be mounted on a single core as in Fig. 1. The field current is supplied from the transformer *T*, to the secondary coils of which the two field windings *b*, *b'*, are connected in shunt. Current from the terminal *v* flows through the inductive resistance *M*, coils *b*, switch *s* and back to the other terminal *v'* of the transformer. Current also flows from the terminal *v* through the switch *s'*, brush *d*, thence through the series connected field windings *b'*, by brush *d'*, resistance *R*, to terminal *v'*. The inductive resistance *M* and the ohmic resistance *R* cause a difference of phase between the two



FIGS. 1 AND 2.

branches of the circuit from the secondary coils of the transformer. The phases in the branch containing the inductive resistance will of course lag behind those containing the ohmic resistance. The poles produced by the coils *b* for one impulse of the current are indicated by the letters *N* and *S*, respectively. Those produced by the winding *b'* are indicated in the same way.

The winding *b'* is termed a series connection field winding, and 19 coils and 19 commutator plates *C*, are shown, numbered 1 to 19, respectively, so that the circuits may be readily traced out. Each terminal of each coil is connected with the terminal of the coil sixth from it, that is to say, separated by five coils. Coils therefore connected in series produce currents in the same direction at the three points of the core approximately 120 degrees apart; and by placing the brushes upon commutator segments separated from each other by two segments, six poles may be produced in the magnet as indicated by the letters *N* and *S*,

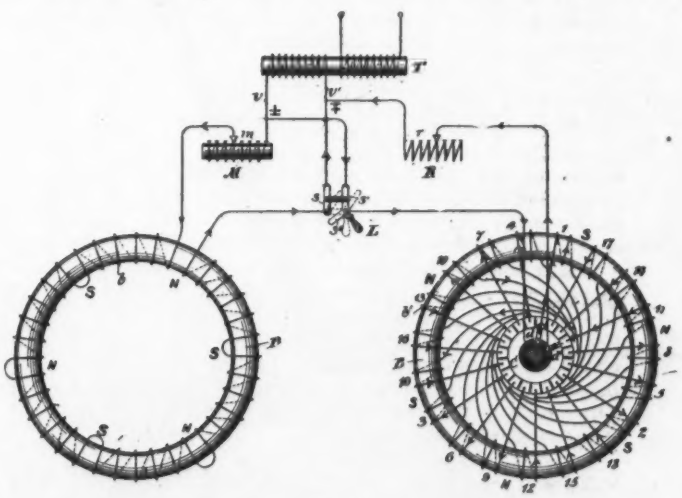


FIG. 3.

respectively. The brushes may be shifted to alter the position of these poles. At starting, the poles should be about midway between the pole produced by the other winding *b* and the currents in the two windings should differ by a quarter of a phase. If the currents differ by less, the angular difference between the poles produced by the two windings should be proportionately less. In practice the proper position will be the one in which the greatest torque is produced with a minimum current.

As the armature acquires speed, the inductive resistance *M* may be reduced by means of the sliding contact *m* and the retardation of the phases in the winding *b* thereby decreased. At the same time the resistance *R* may be cut out by the sliding contact *r* until the phases in the circuits *b'* correspond with those in the circuit *b*. This gradual reduction of the difference in the phase may be effected simultaneously with a shifting of the brushes *d*, causing the poles produced by the two sets

of connections and windings to correspond at the instant the phases correspond. When this has been done the motor is virtually operated by a single alternating current. The field windings b and b' may then be thrown in series by means of the switch lever L breaking the circuits of the switches s and s' and closing the switch s''. The series connection will then be as follows:—from terminal v through contact m (with or without any inductive resistance M), field winding b, switch s'', brush d, winding b', brush d', contact r (preferably with no ohmic resistance R) back to the other terminal v' of the secondary coils t of the transformer T. Either the ohmic or the inductive resistance may be omitted; and the correspondence of the two phases may be produced solely by means of the switch which connects them in series. In the latter case, field windings b' are preferably commutated to correspond to the winding b before the switch s'' is closed.

An Adjustable Tower Wagon.

The accompanying illustration shows a tower wagon designed for the use of the Allegheny County Light Company, of Pittsburgh, Pa. The object in view was to provide a device which could be so adjusted as to reach the highest arc lamp or to pass under trolley wires and bridges, and still be light enough to be handled by two men.

The tower consists of a large step-ladder, hinged at the top and at the foot of the sloping leg. The back leg is adjustable along the wagon floor, enabling the operator to put the apex of the frame at any height above the wagon from the maximum, as shown in the cut, to a position nearly on a level with the wagon floor.

The platform slides up and down guides on the sloping leg of the ladder structure, and is controlled by a winch in the body of the wagon, the handle of which may be seen near the front wheel. The winch has two drums which may be worked independently or simultaneously, by means of clutches on the spindle. One of these drums controls the tower frame and the other raises or lowers the working platform. The latter is provided with hooks which engage with the rungs of the ladder and sustain it at any desired height. The wagon is 5 feet 6 inches wide,

Adjustable Tower Wagon.

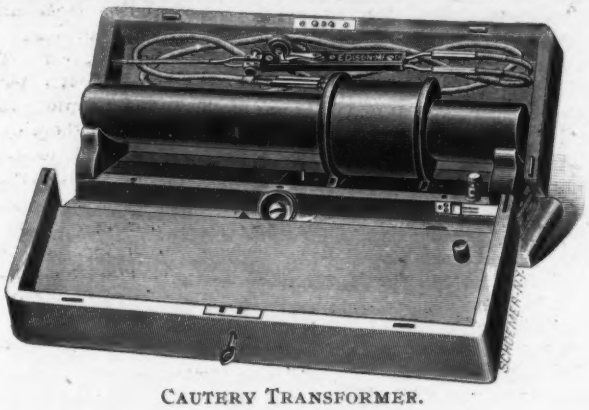
5 feet high, and contains space for all the necessary tools of the line men. The platform is 7 feet long and 2 feet wide and is 24 feet above the ground in the highest position, and 18 feet in the lowest, with the tower up. The whole tower can be lowered to pass under a 13-foot doorway.

Fire Risks in Factories.

A recent dispatch from Waterbury, Vt., to the Boston *Journal* gives an account of the destruction of over $10,000 worth of property by a fire which originated from a hot box in a factory. This would seem to furnish an incentive to the trial of some of the electrical devices for giving an alarm upon the overheating of a journal.

The Kennelly Cautery Transformer.

A very compact, portable transformer has been put on the market by the Edison Manufacturing Company, of 110 East 23d street, New York, the object of which is to enable physicians to use 52-volt or 104-volt alternating current, for electro-cautery and diagnostic lamp purposes. The primary circuit of the transformer is composed of a large number of turns of fine insulated copper wire and is wound around a core of annealed iron wires, the whole being enclosed in a thin cylindrical shell of hard rubber supported by a hard rubber standard at each end. The secondary coil, composed of a few turns of thick wire, is wound on a



Cautery Transformer.

hollow hard rubber spool and moved by a rack and pinion back and forth over the primary coil. The terminals of the secondary coil are brought out to two pin attachments mounted on one head of the coil, and the cautery cords are connected thereto by split socket connections. On moving the secondary coil to the right, the current is increased and vice versa.

The apparatus is mounted in a highly polished mahogany box which opens down the middle, as shown in the cut, and is fitted with a switch at the side which automatically cuts off the current when the lid is closed. It is provided with an attachment plug and 10 feet of flexible cord for connecting the instrument to the mains.

A Prosperous Electrical Supply Establishment.

In the business of general electrical supplies Boston may certainly claim at present a very creditable representation, not alone as to quality, variety and cheapness, but as well for spacious and handsome salesrooms in which abundant opportunity is afforded for display. Following the publication of other interior views we present herewith the interior of the salesroom of the Thompson-Brown Electric Company, of Boston, with headquarters at 97 High street, which for general arrangement compares favorably with any supply house in existence. Although but recently organized its management is not by any means new to the

Supply House Interior.

electrical field. The entire street floor of the building is used for the salesroom and offices, while the basement is devoted to stock and the shipping department. A most complete and varied stock of electrical supplies is carried, conspicuously and temptingly arranged for customers. In the line of street railway material it presents an assortment (all of which are inventions of Mr. George Thompson, Jr., president of the company) claimed to be second to none in existence, while the line of electric lighting and supply specialties embodies everything needed. The concern started with good business recognition from old friends of the management which it has been able to hold straight along, and hosts of new friends and patrons have been made through untiring and energetic effort. In the view presented the executive and clerical staff conspicuously appear.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, May 11, 1895.

AMERICAN BELL performed a sudden gymnastic feat on Wednesday, jumping from 190 to 193 with practically a single spurt, and it has continued bullish throughout. A director of the company states that if the instrument output continues until May 20 as it has since April 20, the instrument account for the month will show as large a gain as last month, which showed a gross increase of 11,277 instruments, and a net gain of 9,722, and was the largest month in the history of the company. It is claimed by some that the strength of the stock is due to the belief that Judge Carpenter's decision was an unjust one and will probably be reversed. As those who are most closely interested have little to say on this score it would appear that this opinion is confined to the more optimistic and less well-informed contingent of American Bell's friends.

NEW ENGLAND TELEPHONE has made its annual report, which shows a surplus for 1894 of $91,917 as compared with $55,761 for 1893. A sixth issue of $500,000 5 per cent. 20-year bonds has been authorized by the directors.

AMERICAN CABLE displayed rather unusual activity this week, on Tuesday reaching a point where none was for sale, and climbing to par to-day.

	Par.	Bid.	Asked
ELECTRICAL STOCKS.			
Chicago Edison Company	100	120	125
Edison Electric Ill., New York	100	100¼	101
" " " Brooklyn	100	..	108
" " " Boston	100	130	..
" " " Philadelphia	100	..	115
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	29	..
General Electric	100	34	34⅜
General Electric, pref	100	..	65
Westinghouse Consolidated, com.	50	34½	35
" " pref	50	52	52½
BONDS.			
Edison Electric Ill., New York	100	105½	105½
Edison Electric Light of Europe	100	75	85
General Electric Co. deb. 5s	100	..	90¼
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	194	194½
American District Telegraph	100	30	40
American Telegraph & Cable	100	95½	100
Central & South American Telegraph	100	117	120
Commercial Cables	100	141	..
†Erie Telephone	100	57	57½
Gold & Stock Telegraph	100	105	..
New England Telephone	100	..	70
New York & New Jersey Telephone	100	103	105
Postal Telegraph-Cable	100	63½	..
Western Union Telegraph	100	93⅞	93½
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	17⅛	17⅝
Binghamton RR. com	100	100	..
Brooklyn Traction	100	11⅜	14
" " pref.	100	..	53
Buffalo St. Ry	100	70	72
Cleveland City Ry.	100	68	70
Cleveland Electric Ry.	100	59	60
Chicago City Ry	100	305	315
Columbus St. Ry	100	48½	..
Consolidated Traction of N. J.	..	26	30
Electric Traction, Philadelphia	50	74½	75
Long Island Traction	100	11¼	12½
Louisville St. Ry. com.	100	37	39
" " " pref.	100	87	88
Metropolitan Traction, Philadelphia	100	96¼	96⅝
New Orleans Traction	100	14½	16
" pref.	100	56	60
North Shore Traction	100	23	28
" " pref.	100	88	93
People's Traction $30 pd.	25	60	60¼
‡Philadelphia Traction	50	83¼	84
Rochester St. Ry	..	38	..
Union Ry. (Huckleberry)	100	112	115
West End, Boston	100	..	69
" " pref	100	90	..
Worcester Traction	100	13	16
" " pref	100	83	87
BONDS.			
Buffalo St. Ry. 1st con. 5s	100	104	105
*Binghamton Railroad Co. 5s	100	99	100
*Columbus St. Ry. 1st 5s	100	98	..
Rochester St. Ry. 1st. 5s	100	95	97
*Union Ry. 1st. mtge 6s	100	105	108
*Westchester Electric 1st. mtge. 5s	100	98	101

* With accrued interest.

† Ex-Div.

‡ Ex-rights.

WESTERN UNION has been kept down for a week by a block of stock for sale around 89½. Traders have run against this stock in their efforts to advance the price and, to some extent, have gone short banking on it. On Tuesday Moore & Schley apparently determined to move Western Union and slowly baled out Mr. Campbell's 2,000 shares. After it had been taken, the price was easily moved to 90, where stop orders took the stock for sale. Above 90, the buying was more general and by people who have been waiting for a chance to buy Western Union on advancing prices.

GENERAL ELECTRIC, despite the fact that local commission houses had been advised to look for a sharp and sudden rise on Thursday, was only firm. No reason has been assigned for the expectation that the stock is about to develop a pronounced advancing tendency other than the previously exploited fact that the business of the company is steadily improving. The consolidation project with the Westinghouse is said to be in abeyance. Possibly, however, developments in that connection are relied upon to stimulate strength in the stock.

THE TRACTIONS are all on a mild boom, a decided advance being noted all along the list, with the exception of Consolidated Traction of New Jersey.

BALTIMORE TRACTION to-day reached its highest point this year, and the annual report shows an increase in net earnings of $15,712 over 1893.

PEOPLE'S TRACTION also reached the highest point to-day since Jan. The gross earnings on Sunday, May 5, were the largest in the history of the company, aggregating $7,501, an increase compared with the same day last year of $4,717.

WEST END is still doing phenomenally well, the gross gains of $1,000 and $1,500 per day being almost entirely net gains to the advantage of the common stock. It is understood that the company has considerably more than $1,000,000 in bank, no debts, and will soon have to consider the problem of distribution of earnings above the 6 per cent. it is now paying upon the common stock. It is not generally known that West End, by changing its dividend days, made an extra dividend last year. What it will do this year cannot yet be told.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 BROADWAY, NEW YORK, May 13, 1895.

THE CONEY ISLAND & BROOKLYN RAILWAY COMPANY has applied for permission to construct a trolley line on Greenwood avenue, from Prospect Park to Greenwood Cemetery.

FRANCHISES DECLARED VOID.—The Nassau & Kings County Electric Railway Companies' franchise for the Union street route, Brooklyn, have been declared void by Justice Smith of the Supreme Court. The court finds that "the franchises were granted for a less sum than could have been obtained from a competing company, and that they were given in bad faith and as a matter of favoritism to the defendant companies." The defendants will probably appeal the case.

THE ELECTRICAL THEATRE SIGNS were all extinguished on Tuesday night of last week, for the first time in many months. The signs had been, in most cases, moved back, but the Bureau of Incumbrances decided that they still infringed the law and ordered them to be left unlighted until they were moved back far enough to conform to the letter of the law. Hence the dismal aspect of the Tenderloin on Tuesday night. Matters were adjusted on Wednesday and the theatre district again rejoices in a blaze of glory, though less advantageously displayed.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, May 11, 1895.

MR. J. S. KEENAN, for a number of years connected with the Holtzer-Cabot Electric Company, has been added to the force of the Thompson-Brown Electric Company as traveling salesman.

THE PETTINGELL-ANDREWS COMPANY has secured an excellent order from the municipal plant at Marlboro, Mass, for wire and line equipment incident to the increase of this plant. It also reports a very gratifying increase in business generally.

MR. H. C. HAWKS, president of the Anchor Electric Company, Boston, has just returned from an extended western trip which included the Pacific Coast. He captured some excellent orders, located several desirable agencies, and was greatly benefited in health by the trip.

MR. P. M. REYNOLDS, the popular treasurer of the Anchor Electric Company, Boston, has been wearing a perpetual cheerful and happy smile all the week because of the appearance last Monday in his charming home of a "bouncing" youngster. If his signature happens to be a little shaky his friends will now know that the many hearty hand-shakes he has received have much to do with it.

English Notes.

(From Our Own Correspondent.)

London, May 6, 1895.

ELECTRIC UNDERGROUND RAILWAYS.—As I reported some time ago a demand for subscriptions, fathered by the Great Northern Railway Company, for an electric tunnel railway running into the city, was not responded to by the public. Since then it has been attempted to alter the terms of the franchise and to obtain permission to use steam in place of electricity in connection with this line. The Standing Orders Committee of the House of Commons has, however, declined to accede to this request.

ELECTRICAL EQUIPMENT OF THE LEEDS POSTOFFICE.—It is unnecessary to state that the entire building will be lit by electricity, but in addition thereto electric motors will be made use of for the purpose of working the pumps in connection with the pneumatic despatch arrangements. Perhaps the most important change is the substitution of secondary for primary batteries for telegraphic purposes. It is estimated that about 200 secondary cells will be sufficient to replace the whole of the primary batteries. Accumulators will also be made use of to supply the currents needed for the large telephone room which is being prepared in view of the acquisition of the trunk telephone lines by the State.

ROYAL INSTITUTION.—Prof. Forbes has commenced a short course of lectures on "Alternating and Interrupted Electric Currents" at the Royal Institution. In commencing his first lecture he remarked that if his audience expected to hear anything about his work at Niagara, which he had just completed, he was afraid they would be disappointed.. He restricted his remarks to magnetic analogues of electrical phenomena, which take place when an electric current is reversed or interrupted. Tesla's experiment of lighting a glow lamp in a rapidly alternating electrostatic field was shown to good effect, Prof. Forbes taking the rapidly reversing charge through his own body. He assured his audience that he felt none the worse for this, and remarked that "no man was ever killed by volts, only by amperes." In the latter part of his lecture the professor explained some magnetic analogues of curbing submarine telegraph signals.

MUNICIPAL ELECTRIC LIGHT FINANCE.—In their report for the year 1894 the electric lighting committee of the St. Pancras vestry stated that their total capital expenditure up to date now amounts to £110,000, and that they have connected to their mains 15,500 incandescents, 129 arcs and 22 motors, and that the net result of the year's working, after providing for bad debts, repayment of loan, interest of loan, etc., is a profit of £1,754, which, they point out, together with the amount set aside for interest and repayment of loans, is equivalent to a dividend of over 6 per cent. on the capital expenditure, and would be available for distribution to the shareholders if the undertaking belonged to a company. An interesting question is raised by the paragraph of the report dealing with the question of creating a depreciation fund. The committee state that they have not set aside anything for depreciation, since they consider that the sums set aside to repay the loan are equivalent to the building up of a depreciation fund. It has however, to be remembered that, so far these loans have been for a period of forty-two years, and it is hardly to be expected that, at any rate, boilers, engines and dynamos, and probably mains, will last anything like that time, so that unless something more is set aside the vestry will find itself shortly under the necessity of raising further loans for the purpose of maintaining the present plant in a proper condition, a not altogether satisfactory result of municipal enterprise.

AGRICULTURAL LIGHT RAILWAYS.—Your readers may possibly recollect that in consequence of a long-continued agitation, the president of the Board of Trade recently called together a conference on light railways, the delegates to which represented all conceivable interests, agricultural and municipal This conference appointed a committee to inquire into the question of cheapening the preliminary expenses, constructional cost and operative cost of railways intended for the purpose of transporting agricultural produce from farms to the nearest market. A report was presented by the committee within a few weeks of the time urging upon the Board of Trade to immediately introduce a bill into Parliament providing for the authorization of such lines by the local authorities, instead of by Parliament, and a radical relaxation of the stringent regulations of the Board of Trade, which they considered were only applicable to lines upon which express trains and heavy traffic is run. On Thursday last a bill, embodying the suggestions of the committee, was introduced by the president of the Board of Trade, and supported by him in a very lucid speech. Owing, however, to the absence of any provision for the subsidization of these lines either by the treasury or by local authorities the bill was received with a chorus of disapprobation. I think, however, that it is not likely that any member representing an agricultural constituency will imperil his seat by factious opposition to this measure, which, although not put forward as a panacea for agricultural depression, may prove, if properly made use of, a decided palliative. Electric traction syndicates, construction companies and what not have lately been forming and reforming in an alarming fashion. It is to be hoped that some one or other of these concerns will take time by the forelock and set to work to educate the English agricultural mind on the marked advantages of electricity for agricultural light railways.

General News.

New Incorporations.

THE WESTERN MARYLAND TELEPHONE COMPANY, Westminster, Md. capital stock $10,000, has been formed.

THE PROCTOR HEATING COMPANY, Chicago, Ill., capital stock $10,000, has been formed to do a general electrical, steam and hot water heating, gas fitting and sewerage business.

THE EMPORIA TELEPHONE COMPANY, Emporia, Kan., capital stock $8,500, has been incorporated by Calvin Hood, L. L. Hallock, S. Strauss, T. H. Dinsmore, David Stone, D. W. Morris and W. R. Irwin.

THE SMITHVILLE WATER & LIGHT COMPANY, Smithville, Tex., capital stock $40,000, has been formed to furnish water and electric light. K. H. McCaskill, R. E. McCoy, L. L. McCoy all of Smithville, are interested.

THE GWYNN'S FALLS RAILWAY COMPANY, Baltimore, Md., capital stock $30,000, has been incorporated by Jos. B. Seth, Henry Clark and others to build an electric road in the western suburbs to Powhatan and Wetheredville.

THE PERRY WATER, LIGHT & ICE COMPANY, Perry, Okla. Ter., capital stock, $150,000, has been incorporated. Wm. E. Caldwell, Benj. J. C. Howe, Indianapolis, Ind., and Edw. S. Gaylord and E. D. Nims are interested.

THE SELLERS MANUFACTURING COMPANY, Chicago, Ill., capital stock $50,000 has been formed to purchase, manufacture and sell railway appliances and supplies. The organizers are James Stillwell, Corwin V. Howell and Frank J. Loesch.

THE WESTERN LIGHT COMPANY, Kansas City, Mo., capital stock $30,000 has been formed to do a general electrical and gas business Chas. A. Gray, Lessia A. Hull, Ed. F. Littleton, and John W. Hull, of Kansas City, Mo., are the promoters.

THE SIOUX RAPIDS ELECTRIC LIGHT & POWER COMPANY, Sioux City, Ia., capital stock $8,000, has been formed to establish and maintain an electric light and power plant. The interested parties are H. D. Smith and M. P. Smith, Sioux Rapids.

THE NUNDA ELECTRIC LIGHT COMPANY, Nunda, Ill., capital stock $5,000, has been formed to furnish electric light and power to the residents of Nunda and Crystal Lake. E. C. McColloum, H. H. McColloum and E. E. McColloum are interested.

THE ABILENE WATER COMPANY, Portland, Me., capital stock $125,000, has been formed to manufacture gas and electricity, machinery, fixtures, etc., for gas, water and electric light plants. Wm. C. Eaton, Edw. D. Noyes and Geo. F. Noyes are interested.

THE PAOLA WATER COMPANY, Portland, Me., capital stock $150,000, has been formed to manufacture gas, generate electricity, etc., also to make fixtures, etc., for such plants. Wm. C. Eaton, Edw. D. Noyes, Geo. F. Noyes, Portland, Me., are interested.

THE NEW ENGLAND TURBINE & FUEL COMPANY, capital stock $1,000,000, has been incorporated to generate, apply and use motive power of all kinds. The promotors are I. W. Derby, Boston; Dexter B. Wentworth, and Chas. H. Crane, Somerville, Mass.

THE GRAFTON TRACTION COMPANY, Grafton, W. Va., maximum capital stock $150,000, has been formed to own build, construct and operate an electric street railway from Grafton to Pruntytown, etc. F. A. Moran, H. M. Sommerville and E. M. Morlan are interested.

THE CITY PARK RAILWAY COMPANY, Portland, Ore., capital stock $25,000, has been formed to build and operate electric railways, electric light plants, own property, etc. S. Z. Mitchell, C. N. Huggins and J. A. Cranston, of Portland, Ore., are interested parties.

THE ZANESVILLE & COLUMBUS ELECTRIC RAILWAY, Columbus, O., capital stock $10,000, has been formed to build an electric railway from Columbus to Zanesville. The interested parties are W. J. Dunzweiler, Albert Adams, A. W. Evans, L. W. Doane, and A. A. Patterson.

THE THREE CITIES ELECTRIC COMPANY, Colorado Springs, Colo., capital stock $100,000, has been formed to acquire, manufacture, own, let, lease, sell and supply light, heat, and power. A. A. McGovney, A. L. Lauton and E. J. Eaton, of Colorado Springs, are interested.

THE CRAWFORDVILLE WATER AND LIGHT COMPANY, Portland, Me., capital stock $300,000, has been organized to manufacture gas and electricity, also machinery and electric light plants. Wm. C. Eaton, Ed. D. Noyes, and Geo. F. Noyes, Portland, Me., are interested.

THE CHAPIN-DOUGLAS ELECTRIC COMPANY, New York, capital stock $10,000, has been formed to manufacture and deal in electrical and mechanical apparatus and supplies. The promoters are Chas. E. Chapin, Greenwich, Conn.; J. S. Douglas and F. W. Douglas, New York.

THE LAWRENCE WATER COMPANY, Portland, Me., capital stock $200,000, has been formed to manufacture gas, generate electricity, and make and sell fixtures for gas, water and electric light works. Wm. C. Eaton, Edw. D. Noyes, and Geo. F. Noyes, Portland, Me., are interested.

THE HARRINGTON, FREDERICA & DENTON ELECTRIC RAILWAY COMPANY, Denton, Md., with a maximum capital stock not to exceed $350,000, has been incorporated by Robt. W. Reynolds, Ezekiel Fleming, H. Harrington, B. L. Lewis, and others, to build an electric road.

THE KITSEE ELECTRIC COMPANY, Camden, N. J., capital stock $75,000, has been incorporated to manufacture dynamos, motors and electrical contrivances of all kinds. The promoters are John M. Carroll, Camden, N. J.; Robt. A. Balfour and Leo. J. Tierney, Philadelphia, Pa.

THE UNITED ELECTRIC TELEPHONE COMPANY, New York, capital stock $50,000, has been incorporated. Norman C. Raff, Frank R. Gemmon, Henry C. Williamson, Albert L. Richardson, Chas. P. Rowland, Henry A. Tobb and F. C. Toepleman, of New York, are interested.

THE WESTCHESTER & WILLIAMSBRIDGE TRACTION COMPANY, New York, capital stock $60,000, has been formed to build and operate a street surface road 5¼ miles long in Westchester County. Geo. P. Morgan, A. P. Stanford, C. J. Tracy, and J. E. Chandler are interested.

THE CONSOLIDATED GAS COMPANY, Jersey City, N. J., capital stock $750,000, has been formed to buy, build, own and operate gas and electric works. Jos. C. Davis, Maplewood, N. J., and Henry A. Jones, Geo. Place, of New York, and Thomas Ewing, of Yonkers, N. Y., are interested.

THE ELECTRIC SCALE COMPANY, Kittery, Me., capital stock $600,000, has been incorporated by W. H. Doble and H. F. Doble, the former as president, and the latter as treasurer, to manufacture electric automatic weighing machines.

THE SHELBYVILLE WATER COMPANY, Portland, Me., capital stock $175,000, has been formed to manufacture gas and electricity, machinery and

xtures for gas, water and electric light plants. Wm. C. Eaton, Edw. D. Noyes, and Geo. F. Noyes, Portland, Me., are the interested parties.

THE MOUNT VERNON TELEPHONE & MESSENGER COMPANY, Mount Vernon, N. Y., capital stock $40,000, has been formed by Horace Granfield, C. H. Ostrander, F. T. Davis and others to operate an electric telegraph or telephone line to connect the towns of Westchester county.

THE EDGEWOOD & SULPHUR SPRINGS PASSENGER RAILWAY COMPANY, Williamsport, Pa., capital stock $10,000, has been incorporated to build an electric passenger railway. The promoters are W. E. Ritter, South Williamsport; C. L. Crouse and Jno. L. Kelly, of Williamsport.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, Ill., capital stock. $5 000 000, has been formed to equip and operate steet railways to be operated by horse power or electrical devices, or other power excepting steam. Those interested are Robt. P. Parker, Richard E. Breed and Jas. F. Dagley.

THE ELECTRIC PORCELAIN & MANUFACTURING COMPANY, Trenton, N. J., capital stock $50,000, has been formed to manufacture every kind of porcelain insulating device for electrical purposes. Carl F. Adam, Fred. F. Warchter and David Crossley, all of Trenton, N. J., are interested.

THE FAIRMOUNT TRANSPORTATION COMPANY, Fairmount, capital stock $12,000, has been formed to do a general transportation business by railways, motor lines, traction engines and wagons between Eugene and Corvallis. Geo. M. Miller, H. A. Barr and L. L. Shell are the interested parties.

THE COLLINGDALE STREET RAILWAY COMPANY, Collingdale, Pa., capital stock $50,000, has been formed to build an electric street railway. The promoters are Henry P. Collins, 1838 Mt. Vernon street; Henry Delaplaine, 205 South 42d street; J. M. West, Jr., 1524 Swaine street, Philadelphia, Pa.

THE WEAVER AND JACQUARD ELECTRIC SHUTTLE COMPANY, Norwalk, Conn., minimum capital stock $1,000, has been formed to manufacture and deal in looms, textile machinery and accessories, mill supplies, etc. Wm. Weaver, Dexter Hitchcock and Edward H. Matthewson are interested.

THE CLEVELAND & PAINESVLLE RAILWAY COMPANY, Cleveland, O., capital stock, $200 000, has been formed to construct and operate an electric street railway between Cleveland and Painesville, O. The promoters are Jno. J. Shiperd, M. H. Solloway, Nelson Moses, J. S. Casement and C. O. Child.

THE LE ROY & NORTHERN RAILWAY COMPANY, Le Roy, N. Y., capital stock $50,000, has been formed to build and operate by steam and electricity a road in Genesee county three miles long. The promoters are C. F. Prentice, D. C. H Prentice, N. B. Keeney, and C. N. Keeney, Le Roy, N. Y.

THE NORTHERN WATER WORKS & POWER COMPANY, Beresford, S. D., capital stock $75,000, has been formed to build, operate and maintain water works plants, electric plants and milling plants. J. L. Potter, Beresford, S. D.; C. O. Potter, Elmira, N. Y., and F. H. Potter, Mellette, S. D., are interested.

THE MULTIFUSE SWITCH COMPANY, Chicago, Ill., capital stock $100,000, has been formed to manufacture, buy and sell electrical and mechanical devices and instruments of all kinds and also do a general manufacturing business. The promoters are Howard M. Carter, Charles B. Carter and Edwin C Lancaster.

THE CLEVELAND, PAINESVILLE & EASTERN RAILWAY COMPANY, Columbus, O., capital stock $20,000, has been incorporated by I. N. Topliff, A. Everett, Chas. W Wasson, and others, to build an electric railway through Cutahiga and Lakes counties, and running from Cleveland to Painesville.

THE HENLOPEN ELECTRIC LIGHT & RAILWAY COMPANY, Lewes, Del., capital stock $250.000, has been organized by Hiram R. Burton, Harry V. Lyons, John Barnes, Chas. C. Stockley, Robt. G. Houston, Daniel Burton, and John M. Richardson, to operate a railway from Lewes to Rehoboth or other places.

THE WARSAW WATER COMPANY, Portland, Me., capital stock $90,000, has been formed to manufacture and generate gas and electricity, also machinery and fixtures for same; build electric light plants, etc., in that city and elsewhere. Wm. C. Eaton, Ed. D. Noyes and Geo. F. Noyes, all of Portland, are interested.

THE SHELBY ELECTRIC RAILWAY COMPANY, Shelby, O., capital stock, $10,000, has been formed to construct, operate, etc., a line of electric or other railway in and between Shelby, Annapolis and Olivesburg, in Richmond and Crawford Counties, O. S. S. Bloom, Albert Moore and C. S. Holbrook are interested.

THE MAMMOTH SPRINGS ELECTRIC LIGHT & POWER COMPANY, Mammoth Springs, Ark., capital stock $100,000, has been incorporated by H. G. King, W. D. Cook, M. J. King and M. H. Cook, to maintain and operate a system of electric lights, generate power by electricity and build and operate telephones.

THE WARWICK STREET RAILWAY COMPANY, Philadelphia, Pa., capital stock $50,000, has been formed to build an electric street railway in Delaware County, Pa. Henry P. Collins, 1,888 Mt. Vernon street; J. Mortimer West, Jr., 1,524 Swaine street, and Henry Delaplaine, 205 South 42d street, Philadelphia, are interested.

THE ESMOND ELECTRIC BLOCK SIGNAL COMPANY, Jersey City and New York, capital stock $100,000, has been formed to acquire and own patent rights, etc., relating to block signals, electrical and mechanical. The promoters are Fred C. Esmond, Brooklyn; Chas. C. Dodge, New York, and Henry Seligman, Hastings, N. Y.

THE MAMMOTH SPRINGS ELECTRIC LIGHT & POWER COMPANY, Mammoth Springs, Ark., capital stock $100,000, has been formed to maintain and operate a system of electric lights, generate power by electricity, build and maintain telephone lines, etc. The promoters are H. G. King, W. D. Cook, M. I. King and M. H. Cook.

THE PHŒNIX CONSTRUCTION COMPANY, Crawfordsville, Ind., capital stock $100,000, has been formed to construct and operate telephone exchanges, steam and electric railways, etc.; electric light and gas plants, etc. The promoters are Noah J. Clodfolfer, Crawfordsville; Jacob Frankel, Isidore Crohs, and Jno. W. Paris, of Indianapolis, Ind.

THE UNITED MOTOR COMPANY, Cleveland, O., capital stock $10,000, ha been formed to manufacture and deal in electrical instruments, machinery, devices, etc., boats, vessels, vehicles and engines propelled by electricity or other motive power. H. H. McKeehan, Jas. H. Hoyt, A. C. Dustin, H. A. Kelley and Gustav von den Steiner are interested.

THE HERBERT KRAFT COMPANY, Red Bluff, Cal., capital stock $100,000, has been incorporated to buy, sell and deal in real and personal property, etc.; buy and sell all kinds of mechanical power, heat and electric lighting plants and works, etc. The interested parties are Herbert Kraft, Geo. H. Kraft, Edward Kraft and Gustave Kraft, Red Bluff, Cal.

THE ESMOND INTERNATIONAL ELECTRIC CONSTRUCTION COMPANY, Jersey City and New York, capital stock $1,000,000, has been formed to acquire and own patents, patent rights, etc., relating to traction matters o every kind. Chas. C. Dodge, New York; Fred C. Esmond, Brooklyn, and Henry Seligman, Hastings, N. Y., are interested.

THE BONTA MANUFACTURING COMPANY, Hoboken, N. J., capital stock $150,000, has been formed to manufacture machinery, etc., for electrical plants, and to do a general electric light business in all its branches, build cars, etc. The promoters are Arthur K. Bonta, Wilbur C. Anderson, Alex. C. Young, Hoboken, N. J., and Jacob Wendell, Jr., New York.

THE KEARNEY ELECTRIC LIGHT & POWER COMPANY, Kearney, N. J., capital stock $50,000, has been formed to manufacture, generate, store and supply, etc., electricity or arc and incandescent electric lights, etc. Geo. F. Woolston, Jr., 40 Wall street, New York; Bertram C. Smith, Brooklyn, N. Y., and William Hanna and Jos. Randall, Kearney, N. J., are interested.

THE CHICAGO & MONTANA MINING COMPANY, Chicago, Ill., capital stock $500,000, has been incorporated to locate and operate mines; operate cable, electric or other roads; erect telephone and telegraph lines; electric and water power plants; also all machinery and appliances necessary therefor. The promoters are Malcolm Dale Owen, Thos. H. Kelley and Edw. Brackett.

THE CHICAGO SUBWAY ARCADE & TRACTION COMPANY, Chicago, Ill., capital stock, $15 000,000, has been formed to construct, own, maintain and operate a system of subways and dummy railways, and to maintain and furnish necessary systems of power, light, heat, ventilation, pavements, conduits and other construction. Chas. F. Griffin, Marvin E. Barnhart and John K. Nelson are interested.

TELEGRAPH AND TELEPHONE.

GREENVILLE, ALA.—The Southern Telephone Construction Company, of Atlanta, Ga., will establish a telephone exchange.

MONROE, LA.—The Monroe Telephone Company has been granted a franchise and will install an exchange plant immediately.

CHATTANOOGA, TENN.—The New Citizens' Telephone Company, of which W. D. Carswell is president, has obtained a franchise to construct a system.

TALLAHASSEE, FLA.—Mr. James D. Randall, of the Telephone & Electric Specialty Company, of Memphis, Tenn., is installing a telephone exchange, for which the Viaduct Manufacturing Company, of Baltimore, is furnishing the switchboard and various other appliances.

ELECTRIC LIGHT AND POWER.

TAMPA, FLA.—An electric light plant is to be established.

LELAND, ILL.—A new electric light plant is to be established.

ST. ALBANS, VT.—A new electric light plant is to be established.

VERSAILLES, KY.—An electric light plant will be erected at Versailles.

ATALLA, ALA.—The electric light plant and water system is to be improved.

HILLSBOROUGH BRIDGE, N. H.—Work on the electric light plant is progressing rapidly.

PALM BEACH, FLA.—An electric lighting plant is to be erected here by Henry M. Flagler.

PULASKI, TENN.—The city will issue $25,000 worth of bonds for the erection of an electrical plant.

MINERS MILLS, PA.—The installation of an electric lighting system at this place is contemplated.

STEPHENVILLE, TEX.—Steps are being taken toward the establishment of an electric lighting plant.

BALTIMORE, MD.—It is reported that a new electric light plant is to be erected on West Pratt street.

ELDORADO SPRINGS, MO.—W. B. Lewis and others have been granted a franchise for an electric plant.

BARDSTOWN KY.—A movement is under way toward the establishment of a $7.500 electric lighting plant.

GRANTSBURG, WIS.—The installation of an electric plant at this place is contemplated by John Ericcson.

McCOMB CITY, MISS.—The installation of an electric lighting plant is contemplated by J. J. Hoyt and others.

BATHGATE, MINN.—The construction of an electric lighting plant at this place is contemplated by G. M. Esterley.

CHERAW, S. C.—The Cheraw Knitting Mills is in the market for an electric light plant for 50 and 100 16 cp lamps.

ENTERPRISE, MISS.—An electric light plant is to be erected by S. H. Gilheman, of Springfield, Ill., and L. B. Bradley.

CARBON, IND.—An electric lighting plant is to be established here by Cox Brothers, who will furnish the town with electricity.

GROESBECK, TEX.—It is reported that an electric lighting plant is to be erected here in the near future by F. Allen, of Kosse.

CHATTANOOGA, TENN.—The mayor may be addressed for information concerning the establishment of a new electric light plant.

WAYNESBORO, GA.—J. J. Loth and T. H. Antrim are interested in the establishment of an electric light plant and water works.

PENN YAN N. Y.—At the next village meeting, May 21, a proposition to appropriate $8,500 for lighting the village will be voted on.

GRAND RAPIDS, MICH.—John H Roberts, of this place, is to erect an electric lighting plant at Mackinac Island in the near future.

ELDORADO SPRINGS, MO.—A 21-year franchise has been granted to W. P. Lewis and others to erect an electric lighting plant in this city.

COLCHESTER, CONN.—The lighting of the streets with electricity is projected. Address City Clerk C. H. Dawley for detailed information.

BALTIMORE, MD.—The extension of the electric lighting system in this city is contemplated. Address Mayor Latrobe for further information.

REVERE, MASS.—It is reported that a franchise is to be granted Arthur Perry to furnish electric lighting to the town for a term of three years.

EUREKA, UTAH.—It is proposed to erect an electrical smelting plant near this city. Col. J. W. Hunt, of Milwaukee, and M. Conover are interested.

MANHEIM, PA.—An ordinance is to be passed granting a franchise to Bailey & Co., of Philadelphia, to establish an electric lighting system in this town.

BALTIMORE, MD.—Sealed proposals will be received at the office of the Bayview Asylum for the erection of an electric lighting plant. Simon I. Kemp is president.

LIVINGSTON, ALA.—An electric lighting plant is to be installed here in the near future. W. K. Smith, secretary of the Commercial Club, can furnish detailed information.

PORTLAND, ME.—The construction of an electric lighting plant on Peaks Island is contemplated at a cost of $5,000. The clerk of the City Council can be addressed for particulars.

ALTOONA, PA.—Work will be commenced soon on the erection of the new building for the Edison Electric Light Company. Engineer Corson can be addressed for particulars.

MARION, ALA.—An electric light plant will probably be established. The same engine which drives the water works pumps will be used to supply the power for the electric plant.

CABLE, ILL.—It is reported that a company has been organized for the purpose of establishing an electric lighting plant at this place. The clerk of the Council can give detailed information.

EAST BRIDGEWATER, MASS.—The question of installing an electric lighting system is being agitated. Address Henry Gurney, president of the Board of Selectmen, for further information.

EVERETT, PA.—A franchise has been granted Percy L. Williams for an electric light plant. The contract for the line construction has been awarded to Williams & Williams, of Middletown, Conn. Water power will be used.

WESTMINSTER, MD.—The Carroll County Electric Light & Power Company has the contract for lighting the city and will put in equipment for 40 arc lights. Communication with manufacturers of arc apparatus is desired.

CHICAGO, ILL.—A. L. Hawley, purchasing agent for the Union Electric Company of Seattle, Wash., will have an office at 255 Wabash avenue after June 1, and will be in the market for a stock of electrical supplies during June and July.

THE ELECTRIC RAILWAY.

FLINT, MICH.—An electric street car line is to be built by Judge John E. Nolan, of Saginaw.

BRUNSWICK, GA.—J. E. Du Bignon and others have applied for a franchise to build an electric road.

BATAVIA, N. Y.—Surveys have been completed for the construction of the Batavia & Northern Railway.

AUGUSTA, ME.—The extension of the Augusta, Gardiner & Hallowell Electric Road is to be petitioned for.

PITTSBURGH, PA.—Oliver Brothers have applied for permission to construct an electric line on Bingham street.

NEW BRUNSWICK, N. J.—A single track trolley road is projected from this place to South Amboy, a distance of 14 miles.

TURNER, ME.—The Lewiston & Auburn Street Railway Company has decided to extend its electric line to this place.

BRIDGEWATER, MASS.—Right of way has been granted the Brockton Railway Company to build a line through this place.

EGG HARBOR CITY, N. J.—It is reported that a trolley road is to be established from Pomona to this place and Manahawkin.

MACON, GA.—The Macon Consolidated Street Railway Company is to extend its line a distance of one mile in the southern suburbs.

NEW ORLEANS, LA.—An ordinance has been passed authorizing the sale of the franchise to operate an electric road on Elysian Field street.

PHILADELPHIA, PA.—The Union Passenger Railway Company has been granted permission to extend its line on certain streets of the city.

WHITESTONE, L. I., N. Y.—The Steinway Railway Company has been petitioned to extend the trolley system to this place and Willetts Point.

LOCK HAVEN, PA.—The Electric Railway Company has been petitioned to extend the line from its present terminus to Main and Fairview streets.

GREEN BAY, WIS.—It is reported that the McCartney Street Railway Company's line is to be extended across the river to the main part of the city.

WORCESTER, MASS.—It is reported that the Worcester & Suburban Electric Railway Company will issue $200,000 worth of bonds to improve its lines.

SPRINGFIELD, MASS.—The Warren, Brookfield & Spencer Electric Railway Company has been granted a franchise to construct a line through this city.

ST. LOUIS, MO.—Permission has been granted the Clayton & Delmar Avenue Railway Company to construct an electric line along Bonhomme avenue to Clayton.

BELLEVILLE, N. J.—A franchise has been applied for by the Newark & Paterson Railway Company to operate an overhead trolley system on Washington avenue.

DOYLESTOWN, PA.—Right of way is being secured for the Bucks County Trolley Company through this place. Frank N. Booz can furnish detailed information.

BLACK ROCK, N. Y.—It is reported that the street railway line is to be extended. The secretary of the Black Rock Business Men's Association can give detailed information.

NEW HAVEN, CONN.—The North Haven Electric Street Railway Company has applied for permission to construct a line on Middletown and Montewese avenue to North Haven.

NEWARK, N. J.—The construction of an electric railway from this city to Paterson is contemplated. B. W. Spencer, of the Passaic & Newark Electric Railway Company, is interested.

EFFINGHAM, N. H.—The construction of an electric passenger railway up the Ossipee Valley, from Cornish to this place, to connect with the Boston & Maine Railway here, is contemplated.

NEW ORLEANS, LA.—It is reported that the Algiers & Gretna Railway is to be converted into a trolley system. The line is four miles in length. W. Holliday is president and can be addressed.

WESTCHESTER, PA.—Work will be commenced shortly on the construction of the Westchester and Downingtown Railway, which is to be built between the points named, a distance of seven miles.

HARRISBURG, PA.—It is reported that the Citizens' Passenger Railway Company and the East Harrisburg Railway Company is to be consolidated under the name of the Harrisburg Traction Company.

NEW BRUNSWICK, N. J.—E. J. and A. Radel have purchased the New Brunswick City Railway and will convert it into a double track trolley road. G. Krueger is to be president and can be addressed.

DANVILLE, ILL.—W. S. Matthias has obtained the privilege of constructing and operating for 20 years an electric railway on the Chicago and Danville Highway, from Danville north to Iroquois County.

BALTIMORE MD —Work has been commenced on the extension of the City & Suburban electric line from Point Breeze to St. Helena. Nelson Perine is president and can be addressed for detailed information.

DANVILLE, VA.—The Danville Street Car Company has sold 150 shares of stock and will use the proceeds in extending its lines along Main street to the suburbs. T. B. Fitzgerald and P. R. Jones are interested.

TROY, N. Y.—The construction of a line to Averill Park, to connect with the Troy City Railway, is contemplated. J. K. Averill, or Superintendent Smith, of the Troy City line, can be addressed for detailed information.

SPRINGFIELD, O.—Attorney H. L. Canfield, of Xenia, has secured the right of way for an electric road from Springfield to Wilmington by way of Clifton, Cedarville and Jamestown. The water power at Clifton will be utilized.

GLOUCESTER, MASS.—Work will be commenced soon on the erection of a new power house for the Gloucester, Essex & Beverly Street Railway Company. The structure will be equipped with the most modern electrical machinery.

QUINCY, MASS.—An ordinance has been passed granting the Quincy & Boston Railway Company the right to extend its tracks through certain streets. The general manager of the road can be addressed for detailed information.

SOUTH WILLIAMSPORT, PA.—Surveys are being made for the construction of an electric railway from this place to Sulphur Springs, a distance of 1½ miles. A company has been organized to build and operate the road with a capital stock of $10,000. The clerk of the Council can furnish details.

BUFFALO, N. Y.—The Buffalo, Kenmore & Tonawanda electric road is doing an increasing business. The cars have been equipped with motors calculated to insure a speed, when desired, of 35 miles an hour. These motors are now being replaced by others that will admit of a speed of 50 miles an hour.

NORTH HEMPSTEAD, N. Y.—An application for a franchise to construct and operate an electric surface road connecting the villages of Roslyn, Port Washington and Great Neck will shortly be made to the joint board of town officers and highway commissioners. Good men and plenty of capital are behind the enterprise.

PERSONAL NOTE.

MR. WILLIAM K. L. DICKSON has resigned his position in Edison's laboratory in West Orange, in order to go into business for himself in an electric light and power company, of which Llewllyn H. Johnson is president. Mr. Dickson is now the electrical engineer and H. C. Douglas, secretary. The company's factory will be in New York.

MISCELLANEOUS NOTE.

THE UNIVERSITY OF WISCONSIN, with a view to encouraging and assisting the most meritorious students in engineering and mechanical arts, has adopted the following policy: Nine engineering scholarships, which entitle the holders to the remission of their incidental fees for the period of two years, will be annually thrown open to competition to all students who have been admitted to the freshman class and are registered in courses leading to degrees in the College of Engineering. Seven additional competitive engineering scholarships, which entitle the holders to the remission of their incidental fees for the period of two years, will be annually awarded to students who are registered in courses leading to degrees in the College of Engineering, and who have successfully completed the required work of the first two years of their respective courses. It is said that the students in electrical engineering will get a large share of these special scholarships.

Trade and Industrial Notes.

MR. FRANCIS R. UPTON, we are requested to state, is not connected with the company which manufactures the Upton arc lamp.

McLEOD, WARD & CO., electrical and mechanical engineers and contractors, formerly at 91 Liberty street, have moved to the Thames Building, corner of Greenwich and Thames streets, New York.

C. HOWARD SCRYMSER has been elected president of the Columbia Telephone Manufacturing Company, of 136 Front street, New York, and will give his personal attention to the management of the company's affairs.

THE CAPO-FARAD BATTERY & APPLIANCE WORKS has been established by Jas. J. Pearson, with offices in the Thames Building, corner of Thames and Greenwich streets, in order to meet the growing demand for the Capo-Farad battery.

THE ELSEN & BREWSTER ENGINEERING COMPANY, electrical and mechanical engineers and contractors, have removed their offices from 143 Liberty street to the Thames Building, corner of Thames and Greenwich streets, New York.

W. R. McLAUGHLIN, representing J. H. Bunnell & Co., passed through Pittsburgh last week, and reports business as being on the upward move. He has booked a number of large orders in and around Pittsburgh and is accordingly jovial.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, has bought the patents and business of the Donaldson-Macrae Electric Company, of Baltimore. Mr. R. Macrae will be associated with the Electric Storage Battery Company.

THE KNAPP ELECTRIC & NOVELTY COMPANY, 7 Warren street, New York, reports a very satisfactory increase in the output of its battery motors since the advent of the warm weather, and anticipates an increase of 50 per cent. over its last year's business.

EUGENE MUNSELL & CO., 218 Water street, New York are distributing copies of a pamphlet price list of mica, which they handle in every shape and grade. A notable and convenient feature is the cipher code, there being a code word for each grade, shape and size in the catalogue.

THE AUTO-PNEUMATIC SIGNAL COMPANY, of Rochester, N. Y., has just completed the installation of its switch and signal system at the junction of the D., L. & W., and W. N. Y. & P. roads, Mount Morris, N. Y. This is the second plant installed for the D., L. & W., the first being at Buffalo, N. Y.

THE ELECTRICAL ENGINEERING & SUPPLY COMPANY, of Syracuse, N. Y., has removed its New York office from 136 Liberty street to the Thames Building, corner Thames and Greenwich streets. Manager Hawkins reports business as being excellent, a number of large switchboard orders having been recently taken.

THE INTERNATIONAL CORRESPONDENCE SCHOOL, of Scranton, Pa., is sending out circulars offering special rebates to those purchasing a scholarship prior to June 1, the rebates ranging from $3.25 to $6.25. There are also several premiums offered with electrical scholarships, consisting of outfits of experimental apparatus.

J. GRANT HIGH & CO., 123 North Third street, Philadelphia, have issued their fourth catalogue of switches and switchboards, which is designated as catalogue D. The book is copiously illustrated and very substantially and handsomely bound and includes in its pages every size and style of knife-blade switch, as well as all kinds of switchboard and tablet board fittings.

THE STOW MANUFACTURING COMPANY, of Binghamton, N. Y., has issued catalogue No. 5 of its flexible shaft and portable drills, taps, etc., for use in connection therewith. One of the most interesting specialties described is a combination portable electric motor, flexible shaft and portable drill, by the use of which the drilling and tapping of holes in heavy pieces of work is greatly facilitated.

THE PELTON WATER-WHEEL COMPANY, of San Francisco, in an elaborate new catalogue, describes its water-wheels, which are made to operate under heads of from 20 to 1,000 feet and for all classes of service. Illustrations are given showing Pelton wheels driving dynamos, both by belts and direct coupling. Detail drawings are copiously used to explain the construction and applications of these wheels

THE VANCE ELECTRIC COMPANY has just been organized for the purpose of prosecuting a general electric contracting and engineering business, and has established offices at 136 Liberty street, New York. Mr. A. S. Vance, the president and general manager of the company, has had a wide experience in electrical work, in the course of which he filled important positions with the old Edison General Electric Company and with Leonard, Izard & Co., and H. Ward Leonard & Co.

THE METROPOLITAN ELECTRIC COMPANY, 186-188 Fifth avenue, Chicago, reports a good demand for the Dayton electric ceiling fan, for which it is the Chicago agent. Some nice orders have already been closed for this season. The company has secured the exclusive agency for the United States for the Ayer self-locking windlass. This windlass has several important improvements over other makes now on the market, and commends itself on first sight to all practical station men.

R. LEO. VAN DER NAILLDEN has been appointed western manager for the Bordeaux Dynamo Brush Company in Chicago, as a consequence of the success with which the Bordeaux Dynamo Brush Company has met in the East since the opening of the New York office Mr. Hugo Benedix, the general manager of the company, has made his permanent headquarters in New York, in the Postal Telegraph Building. The company, in order to satisfy the every day increasing demands, has been obliged to secure its own rolling mill.

THE GOULDS MANUFACTURING COMPANY, Seneca Falls, N. Y., reports the following recent sales: The Solvay Process Company, Syracuse, N. Y., one 12-inch x 12-inch triplex power pump, with steel ball valves, to be used for pumping waste; New Orleans Railway & Supply Company, New Orleans, La., two 5-inch x 8-inch triplex power pumps, to be direct driven by one electric motor; Freydenburgh Falls Pulp Company, Plattsburgh, N. Y., one 10-inch x 12-inch triplex power pump; Michigan Alkali Company Wyandotte, Mich., three 6½-inch x 8-inch triplex power pumps; Hanlon & Co., New Orleans, La., two 5-inch x 6-inch triplex power pumps; Robinson & Cary, St Paul, Minn., one 4-inch x 4-inch triplex power pump. The factory is very busy on triplex pumps at the present time, and shipped from its warehouse last week the largest tonnage that has ever been shipped in one week from the works of the Goulds Company.

THE BUCKEYE ENGINE COMPANY, of Salem, O., about two years ago installed in the enormous plant of the Hadley Company, at Holyoke, Mass., a triple expansion engine of 1,000 horse-power, but not until recently has there been a chance to test its full capacity. The opportunity was afforded by reason of the recent high water which absolutely "drowned" the water-wheels so that they could not be run to any advantage. Consequently, the steam engine had to take nearly all the load usually carried by the water-wheels in addition to its regular load, and under these conditions Engineer Clifford reports an average showing of 1,300 horse-power, or 25 per cent. above the rated capacity of the engine. It might be well to state that these engines are rated at 900 horse-power, nominal. This record is one of which the Buckeye Engine Company has reason to be proud. It also has reason to congratulate itself upon the energy exhibited by Mr. W. D. Hoffman, its New England agent, with headquarters at 620 Atlantic avenue, Boston, who is not only quick and keen to bring to the front such important features of its engine, but who is also doing an excellent business for it. Some of the recent sales made for it by him are the Jay Paper Company, Jay, Me.; Morgan Construction Company, Worcester, Mass., and Glen Manufacturing Company, Berlin Falls, N. H.

THE STANDARD ELECTRIC COMPANY, of Chicago, according to the financial editor of the Chicago *Sunday Tribune*, has increased its capital stock from $1,000,000 to $1,500 000 in order to provide increased facilities that will enable it to promptly and properly care for recent orders, and be the better prepared to handle future business. It also elected to the presidency Mr. A. G. Spalding, the well-known lover of field sports, who has purchased a large block of stock and will take hold with his accustomed energy. Mr. S. P. Parmly will remain in the directory, but concluded to resign the presidency, owing to the health of members of his family necessitating prolonged absence on his part. Mr. E. E. Crepin will continue to be treasurer, and Mr. D. P. Perry the general manager. The remaining members of the directory are Mr. Gilbert B Shaw, president of the American Trust & Savings Bank of Chicago; Mr. J. P. Whitney, a capitalist of Philadelphia, and Mr. G. A. Rollins, a capitalist of Boston. The Standard Electric Company claims the credit of having defeated the plans to compel the World's Columbian Exposition to pay a price for the electric lighting that would have been practically prohibitive, and of establishing the rate that enabled the exposition officials to secure the 4,000 arc lamps for nearly one-half the sum originally called for. Moreover, the service plant that the Standard Company installed in Machinery Hall not only supplied 25,500,000 arc lamp-hours, or nearly 20 per cent. more than any other arc plant at the exposition, but accomplished all this without the loss of an armature or even an armature coil. As the company has under consideration the leasing of one of the largest factories in the West, manufacturers of machine tools will be interested in this note.

Business Notices.

ELECTRIC LEAGUE.—Meets every Thursday evening, 100 West 24th street. Electrical engineers and electricians cordially invited.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED MAY 7, 1895.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

538,648. ALTERNATING CURRENT MOTOR; E. Arnold, Zurich, Switzerland. App. filed July 10, 1894. Method of starting and operating motors or alternating and similar currents by supplying current to the field coils in a manner to produce poles at certain points, and current of different phase in a manner to produce poles at an angle with the said first poles, thereby producing a rotary field; and thereafter diminishing the said angle by commutating or changing the field connections.

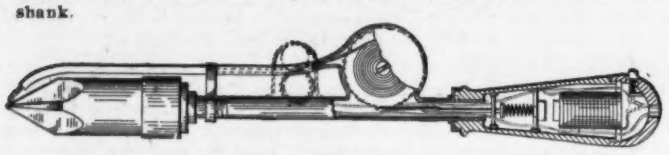
538,649. App. filed April 30, 1894, and 538,650, app. filed June 11, 1894. Closed Conduit Electric Railway; Geo. E. Baird, Chicago, Ill. The combination of a main track and suitable contact devices to carry current from the track to the vehicle and return.

538,651. TELEGRAPH KEY; C. W. Bradford, Clinton, Me. App. filed Feb. 21, 1895. The combination of a base, key lever and a contact post, a stem loosely connected with the inner end of a bar or lever, and a button on the key through which the stem loosely passes, having a disc at the upper end of the stem, and a pin passing through the disc and button to prevent the former from turning independently of the latter.

538,669. SAFETY DEVICE FOR ELECTRIC MOTORS; R. Eickemeyer, Yonkers, N. Y. App. filed July 13, 1892. The combination of a shunt motor connected with the main line, a fusible cut-out between them, so arranged that any disturbance of the circuit will short circuit the motor.

538,670. ELECTRIC TRANSFER SWITCH; A. Ekstrom, Lynn, Mass. App. filed Sept. 7, 1893. An electric switch having a set of terminals connected with the positive wires, and two or more sources of current, also a corresponding set of terminals connected to the wires of the negative circuits, all of the positive being in the same plane, and all of the negative being in another plane parallel thereto, a switch arm which is adapted to vary the connections between them.

538,695. ELECTRIC SOLDERING IRON; W. H. Osborne, Prince's Bay, N. Y. App. filed Feb. 18, 1895. The combination of a soldering head, a heating core for it, a hollow shank carrying conductors, and a hollow handle on the shank.



No. 538,695.—Electric Soldering Iron.

538,700. ELECTRIC ELEVATOR; G. H. Reynolds, New York, N. Y. App. filed Jan. 27, 1890. The combination of an elevator, a counter-weight, a cable and an electric motor, adapted to operate the hoisting gear of the elevator, and a cut-out switch adapted to be actuated by the sag of said cable should it slacken, and automatic connection to cut off the cut-out when the pressure is restored.

538,744. SPEED REGULATOR FOR ELECTRIC MOTORS; F. B. Rae, Detroit, Mich. App. filed Aug. 28, 1894. A motor having a rheostatic switch controlling it, a friction drive mechanism for actuating the contact end forwardly, and devices controlled by the pressure of the motive fluid for returning the hand.

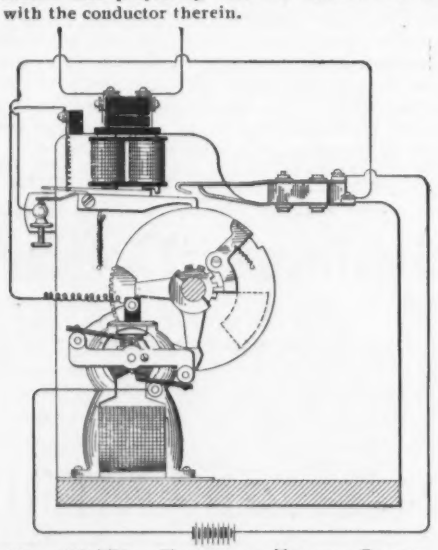
538,757. DYNAMO ELECTRIC MACHINE; A. G. Waterhouse, Pittsburgh, Pa. App. filed Feb. 4 1889. The combination of a field magnet having two poles, each derived through three or more pole pieces, two contact brushes connected with each other through the work circuit and a third brush applied to the commutator in advance of the line of maximum commutation, and connected with a point on the commutator of different potential.

538,758. PREVENTING ELECTROLYSIS OF SHEET PIPES; R. Watkins, San Francisco, Cal. App. filed June 25, 1894. A method of prevention which consists in connecting the pipes with the trolley return conductor by means of suitable conductors, and also connecting the pipes with the power station generator; and also for the use with above combination of plugs screwed into the pipe.

538,764. ELECTROTHERAPEUTIC APPARATUS; F Borsodi, Magyar-Banhegyes, Austria-Hungary. App. filed Oct. 22,1888. The combination of plates secured together to form a recess with a volatile pile located in said recess, a ball secured to the plates and electrically connected with the pile by wires.

538,778. ELECTRIC TOWER CLOCK; J. H. Gerry and F. M. Schmidt, Brooklyn, N. Y. App. filed Nov. 15, 1894. The combination of a notched and weighted disc having means for connecting it to the clock train, an armature lever controlling said disc and a local electric clock circuit, including a normally closed pair of contacts controlled by the armature.

538,786. ELECTRIC RAILWAY; H. R. McLean and G. A. Kornetzke, Schenectady, N. Y. App filed Aug. 3, 1894. A conduit formed adjacent to a rail upon which the vehicle travels and containing an electric conductor in combination with a vehicle wheel provided with a concentric insulated spring mounted metallic disc projecting into the conduit and making electric connection with the conductor therein.



No. 538,773.—Electric Tower Clock.

538,816. TELEGRAPHIC SOUNDER; J. H. Bunnell, New York, N. Y. App. filed April 19, 1893. The combination of an armature provided with adjustable limiting stops, a cradle upon which the electromagnet is mounted, the cradle being pivoted concentrically with the armature, and an adjustable screw near the free end of the cradle.

538,825. COMMUTATOR; J. P. B. Fiske, Alliance, O. App. filed Feb. 9, 1895. The combination of an armature with a sleeve secured to the hub, a flange projecting from the sleeve, a plate or cap, bolts securing the flange and plate together, commutator segments between the flange and plate and interlocking flanges projecting from the cap and sleeve.

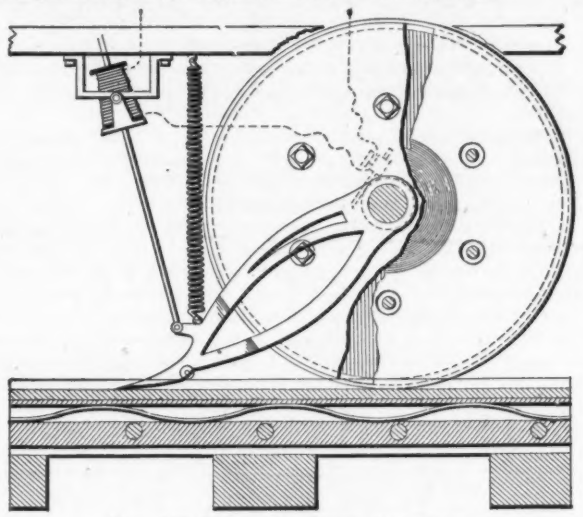
538,888. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS; W. Lawrence, New York, N. Y. App. filed April 28, 1894. The combination of a series of junction boxes each consisting of a rigid wall or casing, and a movable portion as a diaphragm constructed and arranged to support a service conductor, and an intermediate air-tight flexible joint and a superimposed sectional bar service conductor, one box being located near each end of a section of said working conductor and arranged to hold it in normal position or support the same.

538,844. TROLLEY BAR; C. Parker and A. R. Trepagnier, New Orleans, La. App. filed July 18, 1894. A trolley bar carrying the lower wheel at its end, a supplemental bar pivoted onto the main bar, the upper wheel at the forward end of the supplemental bar and a spring attached thereto, which tends to bear down the upper wheel on the top of the wire.

538,904. ELECTRICAL CONNECTION; J. M Faulkner, Philadelphia, Pa. App. filed Feb. 28 1895. The rail ends having wells containing mercury, the bond having its ends driven into and closing said wells with its points entering the mercury.

538,919. ABSORPTIVE MATERIAL FOR STORAGE BATTERIES; E. R. Knowles, Brooklyn, N. Y. App. filed Oct. 15, 1891. A method of forming an absorptive material, which consists in first mixing red oxide of lead and yellow oxide of lead, and then subjecting the mixture to a complete process of sulphation before its application to battery plates.

538,971. CAUTERY ELECTRODE; M F. Laughlin, New York, N. Y. App. filed March 7, 1894. The combination of a platinum wire loop, a loop handle, a movable resisting bar provided with grooves to take in the cauterizing wire and electric circuit wires to establish contact.



No. 538,786.—Electric Railway.

538,975. TELEPHONE SYSTEM; J. W. McDonough, Chicago, Ill. App. filed May 21, 1891. A telephone system comprising an apparatus provided with circuit wires means for connecting any two of them together, telephonic receivers, a spring connected with the electric current passing through a space allotted to a subscriber and moving over a surface corrugated to correspond with the undulations of a spoken word, and a telephonic transmitting device operated by the same for throwing a signal to a subscriber's station when the spring is moving over the space allotted to such subscriber.

538,983. INTERIOR CONDUIT; O. G. Traphagen and F. W. Fitzpatrick, Duluth, Mich. App. filed Feb. 4, 1895. A flat strip suitable for conveying wires, pneumatic tubes, etc., comprising a channel and a molding secured to each side of it, and a face or plate held in place between the moldings and supporting the wires, tubes, etc., within the channels.

538,999. ELECTRIC ARC LAMP; S. S. Allen, London, Eng. App. filed, Oct. 29, 1894. An electric lamp having its carbon holders connected by a chain passing over guide pulleys and a sprocket wheel geared to an escapement which is governed by a brake, and a lever having its one arm linked to the core of a solenoid mounted on its other arm, the guide pulley from which the chain leads to the lower holder, and another lever secured to the brake lever so that the escapement is released when the lamp is not in circuit.

539,000. ELECTRICAL HOSE SIGNALING APPARATUS; W. Fowler, Colorado Springs, Col. App filed June 20, 1894. The combination of two coupling parts and the conductors carried by the hose, an insulating ring suitably attached to one part and provided with recesses, whose centres lie in the same circle, contact plugs located in said recesses and normally projecting therefrom, their outer extremities being beveled, and the plugs so arranged that said extremities lie in different circles, coil springs located in their recesses, one extremity of each spring being attached to the plug, while the other extremity is carried out of the recess and connected with the conductor carried by the hose.

539,017. ELECTRICALLY ARRANGED HOSE COUPLING; W. Fowler, Colorado Springs, Col. App. filed Nov. 30, 1894. This patent is substantially the same as the above.

539,019. ELECTRIC LIGHTING SYSTEM; R. N. Chamberlain, New York, N. Y. App filed Oct. 22, 1894. The combination of a source of mechanical power, an alternating current generator, a direct current generator, a translating circuit connected to the alternating current generator, storage batteries connected with the direct current generator, means of disconnecting the current generator from the source of mechanical power, and means for mechanically connecting the direct current machine as a motor to the said alternating current generator.